INTERDISCIPLINARY KNOWLEDGE TRANSLATION AND EVALUATION STRATEGIES FOR PARTICIPATORY DENGUE PREVENTION IN MACHALA, ECUADOR

by

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Abstract

This dissertation explores how knowledge management approaches and socio-political systems affect the accessibility to and application of evidence to improve the health of socially and politically disempowered groups of people. As, dengue provides a particularly vivid example of a human health issue intricately linked to biological, environmental, social and political systems, this study is embedded in a participatory dengue prevention and control program in Machala, Ecuador, that is committed to capacity-building and scaling-up. Guided by a transformative emancipatory approach with a focus on equitable participation, a multi-method approach was pursued including ethnographically-framed stakeholder analyses, social network mapping and analysis, illustrative vignettes and participatory indicator development. Six major stakeholder groups were identified in Machala: community, local government, government functionary, government administrator, researcher and private sector. Varying degrees of collaboration and interaction with one another as well as with the problematic of dengue are shaped by the dynamics of differing health priorities, paternalism/equitable participation, quemeimportismo/social resentment, nepotism/centrism/social justice, marginalization/self-determination and Buen Vivir. Power dynamics and knowledge valuation schemes dictate definitions of success and shape evaluation tools and processes tend to marginalize experiential and tacit knowledge, perpetuating narrow conceptions of health, benefit and dengue transmission risk. Overall, opinions regarding evaluation criteria did not significantly differ by stakeholder group, which suggests that social and cultural dynamics, as well as history and narrative of place, may be far more important factors in determining both stakeholder priorities and the character of intersectoral spaces than previously thought. A participatory evaluation tool is developed to assess both impact and process-related performance of proposed dengue prevention and control strategies. A knowledge translation model is developed with a strong emphasis on equitable participation and health equity. This study observes that there is deep need for change in underlying institutional
power structures and research-to-policy processes, without which new evaluation tools will likely not “make sense” or result in improved policy, programs and community well-being. These findings and their implications challenge current macro, mid and local-level knowledge management strategies. This study indicates that opportunity for change exists through participatory evaluation processes situated at the interface of equitable knowledge translation and social determination.
Preface

The research described in this thesis was conceptualized, designed and written up in full by myself, Kendra Mitchell-Foster, but is situated operationally within a larger three-year project called “Meeting capacity-building and scale-up challenges to sustainably prevent dengue in Machala, Ecuador” (EBS-Ecuador). This larger project, built on the foundations of the pilot projects for Masters of Health with and Ecosystems Focus theses elaborated by Dr. Efraín Beltrán Ayala and Dra. Ana Arichabala Wilches in 2008, was designed and written through a collaborative research team comprising Dr. Jaime Breilh Paz y Mino, Dr. Jerry Spiegel, Dr. Efraín Beltrán Ayala and myself. The original proposal for the EBS-Ecuador project then underwent major revisions made by Dr. Efraín Beltrán Ayala and myself at the proposal development workshop for the UNICEF/UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases (TDR) and International Development Research Centre (IDRC) Innovative Community-based Ecosystem Management Interventions for Improved Chagas Disease and Dengue Prevention in Latin America and the Caribbean held in Antigua, Guatemala, in July 2009. This newer iteration of the EBS-Ecuador project was further developed by the full research team and was funded in early 2010. The ecosystems approach for this work is described as Eco-Bio-Social (EBS), a three pronged approach to identifying, investigating and addressing determinants of health and disease risk through ecological, biological and social forces. The research presented here was designed and developed by me to address specific elements of the determination, determinants and risk factors within the social arm of inquiry of the overall EBS project design.

I undertook all ethnographic observation and analysis, interviews and focus groups, and with the exception of rough transcription support from research assistant Kelly Garton on three of the 41 sessions, were transcribed, coded and analyzed by me. I had the pleasure of working with a SNEM health promoter/vector control worker throughout the participatory indicator data
collection process; Sra. Patricia Zhinin helped to administer surveys to participants, coordinate meetings and follow-up with home visits and telephone calls. The community participation, empowerment and well-being survey was administered to 1888 EBS-Ecuador project participants through the SNEM-based field brigades in conjunction with routine home visits as part of the overall project protocol. I undertook all instrument design, data entry, analysis, development of outputs and theories, and writing specific to this thesis. Robert Balshaw of the British Columbia Centers for Disease Control advised me on the use of principal component and hierarchical clustering analyses.

This study was approved by the UBC Behavioural Research Ethics Board (certificate H11-01327), and the overall EBS-Ecuador project within which this research is embedded was approved by the UBC Behavioural Research Ethics Board (certificate H10-00568) and the World Health Organization Ethics Review Board (ID A90294 / T16-TSA-225). This study was funded in part by the TDR-IDRC EBS-LAC initiative, and in part by a three-year Frederick Banting & Charles Best Doctoral Fellowship Canada Graduate Scholarship from the Canadian Institutes for Health Research awarded to me, Kendra Mitchell-Foster.
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<td>BI</td>
<td>Breteau index</td>
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<tr>
<td>CBAR</td>
<td>Community-based action research</td>
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<tr>
<td>CIHR</td>
<td>Canadian Institutes for Health Research</td>
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<tr>
<td>COMBI</td>
<td>Communication for behavioural impact social mobilization approach</td>
</tr>
<tr>
<td>CoP</td>
<td>Community of practice</td>
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<tr>
<td>CSDH</td>
<td>The WHO Commission on the Social Determinants of Health</td>
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<td>DEN</td>
<td>Dengue</td>
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<td>DENV</td>
<td>Dengue virus</td>
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<td>DF</td>
<td>Dengue fever</td>
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<td>DIT</td>
<td>Roger’s diffusion of innovation theory</td>
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<td>DPSEEA</td>
<td>WHO-developed framework based on Driving force, Pressure, State, Exposure, Effect, Action</td>
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<tr>
<td>DSS</td>
<td>Dengue shock syndrome</td>
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<td>EBP</td>
<td>Evidence-based practice</td>
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<td>EBS</td>
<td>Eco-bio-Social approach to prevention and control of vector borne disease incorporating the analysis and addressing of ecological, biological and social risks and risk factors for vector-borne disease transmission through participatory strategy</td>
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<td>EBS-Ecuador</td>
<td>The Ecuador project &quot;Meeting capacity-building and scale-up challenges to sustainably prevent dengue in Machala, Ecuador&quot; as part of the TDR-IDRC multi-country study</td>
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<td>EBS-LAC</td>
<td>The Latin America and Caribbean Eco-Bio-Social community of practice as it applies to the current EBS- LAC dengue and Chagas disease prevention and control projects funded by TDR-IDRC partnership</td>
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<tr>
<td>EcoHealth</td>
<td>An ecosystems approach to human health</td>
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<td>EF</td>
<td>Effectiveness</td>
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<td>EN</td>
<td>Engagement facilitators</td>
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IDRC: International Development Research Centre
HI: House index
INSOC: Social insertion index
KT: Knowledge Translation
LAC: The Latin America and the Caribbean WHO region
MoH: Ecuadorian Ministry of Health
MoE: Ecuadorian Ministry of Environment
MoEd: Ecuadorian Ministry of Education
ND: Neglected disease
NTD: Neglected tropical disease
OS: Operational sustainability
PC1-5: Principal components one through five
PCA: Principal component analysis
R&R: Resilience and responsiveness
SD: Severe dengue
SDH: Social Determination of Health
SMCE: Social multi-criteria evaluation
SNEM: Servicio Nacional de Eradicación de Malaria (translation: National Malaria Eradication Service) is the vertical national vector control programme within the Ecuadorian Ministry of Health. Although the acronym persists as SNEM, this branch of the MoH has been aptly renamed Servicio Nacional del Control de Enfermedades Transmisibles por Vectores Artrópodos (translation: National Service for the control of Arthropod Vector-borne Diseases)
TDR: The UNICEF/UNDP/World Bank/WHO Special Programme for Research and Training on Tropical Diseases
TEP: Transformative emancipatory paradigm
UNICEF: United Nations Children’s’ Fund
UNDP: United Nations Development Programme
UASB: Universidad Andina Simón Bolívar
UBC: University of British Columbia
UTM: Universidad Técnica de Machala
WHO: World Health Organization
YFV: Yellow fever virus
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First and foremost I extend a deep gratitude toward the 2000 families and other community members in Machala who graciously and generously opened their homes and their lives to me and to the possibility of forming relationships in hopes of earnest collaboration. Thank you in particular to Bismarck Piñeda, Rodrigo Lozano, José Palas, Vincenta Salinas, and Clorinda Loayza.

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Thank you to the team at Universidad Andina Simón Bolívar for their inspired work with social determination and critical epidemiology, for pushing the agenda of *Buen Vivir* into the spaces of research, policy, programs and practice, and for allowing me to learn and work with them. Thank you to Dr. Jaime Breilh Paz y Mino, María José Breilh Ayora, Ylonka Tillería, Bayron Torres, María Luisa Espinoza, Sonia Figueroa, Monica Izurieta and Dr. Enrique Ayala Mora.

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Thank you to my family and friends for their encouragement and undying belief in me over the past 5 years and beyond. I am a better human being for the gentle and constant influence your love has in my life; you have all helped me to navigate life, stay humble, maintain my integrity and encouraged me to push my own limits. Hugs, kisses and thank-yous to my wife, my parents, my sister, Dan, Kira, Jake, Jan, Alice & Bill, Ben Brisbois, Dawn Cooper, Uncle Kevin, Uncle Guy, Auntie Enid, Gaetane, Eric, Amma, Auntie Kathy, Alanna & Adam, Zen, Jai, Cole, Rhoda & Jesús, Ruth, Valerie Alberts, Andrea Taylor, Jens & Silvia, Kathryn Ransdell, Tim Scorer, Gary Paterson, Lorna Seaman, Jimmy Baldwin, Don Amero, and Shirley Etter.
Dedication

This thesis is dedicated to God and to my wife, Sheona Mitchell-Foster, without whom the pastures would not have been so green, the waters not as calm, and darkness of the valley far more fearsome; the three-strand cord is not easily broken.
Chapter 1 - Introduction to the Study

1.1 Setting the scene

This dissertation explores how knowledge management strategies and socio-political systems affect the accessibility and application of rich, multi-faceted evidence to improve the health of socially and politically disempowered groups of people.

Since the Alma Ata declaration in 1978, definitions of health have moved beyond a basic understanding of health as an absence of disease toward a holistic conception that includes social, cultural, political, environmental, biological and spiritual elements [1-7]. Newer paradigms and approaches to human health research and addressing complex related health issues at the individual, community and population levels have emerged to accommodate these broader definitions. One-Health, EcoHealth, Eco-Bio-Social, community-based action research, evidence-based public health and the DPSEEA framework guide investigation into the nature of the relationships between human health, non-medical determinants and global-level social and economic forces like globalization [8]. Such inclusive concepts of human health have precipitated a call for equally holistic and interdisciplinary methodologies, programs, policy and communities of practice. Interdisciplinarity presents a particular opportunity to bring together expertise from disparate fields to address complex health issues, developing new strategies based on the varied experiences, capacities and kinds of knowledge pertinent to each discipline [9-11]. A main challenge to interdisciplinary research and collaboration, however, remains building bridges between disciplinary silos and community to make knowledge from each group accessible to one another, and move knowledge and research to action [9, 12].

Dengue virus (DENV), and the febrile diseases it causes, provides a particularly vivid example of a human health condition intricately linked to biological, environmental, social and political systems that requires interdisciplinary thinking
and intersectoral collaboration to find sustainable strategies to reduce, if not prevent, the negative impact of the disease [13, 14]. Infection with DENV in humans results in a spectrum of illness dependent on virological, immunological, physiological and environmental factors. Symptoms can range from subclinical or a mild febrile illness to classical dengue fever (DF) to the more serious and often fatal severe dengue (SD) and dengue shock syndrome [15-21]. Dengue virus is a single-stranded positive-sense RNA virus, of which four human serotypes exist (DENV1-4) [15, 21, 22]. All human serotypes of DENV are maintained and spread via a direct human-mosquito transmission cycle (Figure 1) with the principal vector being *Aedes aegypti* and the secondary but increasingly important vector *Ae. albopictus*.

![Figure 1 - Dengue virus transmission cycle](image)

*Aedes aegypti* is a peridomestic anthropophilic mosquito that thrives in urban and peri-urban settings. This mosquito is so well adapted to living among humans, it nearly exclusively feeds on human blood and preferentially oviposits in confined water containers associated with human activity and is often found immediately around or inside human dwellings [21, 23-25]. *Aedes aegypti* has a holometabolous life cycle with an egg stage followed by four aquatic larval instars, an aquatic pupal instar and a free-flying terrestrial adult stage that emerges from the containers into the domestic or peri-domestic environment to seek blood hosts (Figure 2). Both the number of hosts that an infected mosquito bites and the spatial association between these hosts can affect the DF/SD
incidence during either endemic or epidemic DENV transmission. The more human hosts an infected mosquito probes to complete her bloodmeal, the greater the incidence of DF that can be attributed to her; on a population level, this aspect of \textit{Ae. aegypti} biology carries epidemiological significance [26].

![Aedes aegypti life-cycle](image)

\textbf{Figure 2 - Aedes aegypti life-cycle [27]}

Neighbourhoods marked by sub-standard housing and densely populated with people susceptible to circulating DENV serotypes are considered at high dengue transmission risk especially when residents intentionally store water due to lack of running water, or where water accumulates in containers due to lack of sanitary infrastructure and garbage collection services [13]. Accordingly, issues of housing, provision of basic services and sanitary infrastructure, vector ecology, human population density, accessibility of health services and human behaviour combine under the driving forces of globalization and poverty to create an environment conducive to dengue transmission. Interdisciplinary strategies and interventions addressing issues ranging from land-use, water stewardship, public works, governance at multiple levels, vector ecology, social determinants of health, education, solid waste management, environmental management, clinical management and curative health services, health promotion and preventive
health programs, human security and political agency are thus needed. This requires significant effort to build intersectoral spaces, foster equitable intersectoral collaboration and to share, mobilize and implement evidenced and tacit knowledge [28]. Community participation is widely accepted to be a crucial element in determining the success and sustainability of interdisciplinary dengue prevention programs [13, 21, 29-32].

Building on circumstances where knowledge about health conditions and the factors that affect them is continuously expanding, Knowledge Translation (KT) has been receiving growing attention as a conceptual framework for understanding and guiding how some of the major challenges to interdisciplinarity may be addressed [33-35]. Indeed with varying degrees of success, KT has been and continues to be implemented as a means to strengthen intersectoral spaces, facilitate collaboration and improve the translation of research results to health impacts [36]. KT is increasingly popular in the field of global health and due to its applied nature has been adapted for use in participatory research. Recognition of the importance of evaluation is implicit in the cyclic process of KT, i.e. with respect to evaluation of available knowledge, supportive and antagonistic forces influencing its use, needs of information users, uptake of knowledge and impact of knowledge use as it pertains to an identified issue [34, 37]. KT and evaluation within the scope of interdisciplinary communities of practice and intersectoral collaboration should be inclusive to a wide range of knowledge and serve to facilitate innovation through equitable participation.

Importantly, KT should be contrasted with knowledge management, understood for the purposes of this dissertation to be institutional strategies for the use, cultivation, application and leveraging of possessed knowledge assets in the form of people, knowledge products, and/or technology, to fulfill institutional mandates, improve outputs, and/or achieve a competitive edge [38-41]. In this sense, KT as a process that can be engaged to promote and sustain
intersectoral, transdisciplinary and community-based health endeavours (see section 2.4 of this thesis), interfaces with the siloed and mandated knowledge management strategies of the institutions and sectors that it seeks to bridge.

It is on the basis of the perspectives discussed above that I sought to investigate the processes whereby appropriate knowledge could be generated to most effectively engage those with a stake in its application, by considering a global public health challenge that provided a fitting opportunity for this examination.

1.2 An international effort to strengthen dengue prevention and control

Dengue fever is the most important viral mosquito-borne disease worldwide and is increasing in geographic range and incidence at an alarming rate [13, 21, 42]. An emerging and re-emerging infectious disease, nearly half the world’s population (approximately 2 billion people) is estimated to be at risk for dengue infection, with the majority of this susceptible population in lower and middle-income countries [42-44]. Declared a “public health emergency of international concern” in 2005 by the 58th World Health Assembly, the dengue fever annual incidence rate is between 2.5 and 5% of the at-risk population resulting in approximately 50 – 100 million cases and 20 000 deaths annually [21, 42-45].

Despite its global relevance, dengue fever (DF) has been classified as a neglected disease (or neglected tropical disease – NTD) by the World Health Organization (WHO) and shares this designation with 16 other diseases (Chagas’ disease, leprosy, leishmaniasis, onchocerciasis, dracunculiasis, schistosomiasis, lymphatic filariasis, trachoma, African trypanosomiasis, treponematoses, rabies, Buruli ulcer, cysticercosis, food-borne trematode infections, echinococcous, soil-transmitted helminthiases) [46-48]. Neglected diseases are described as diseases of poverty, affecting the world’s poorest and most marginalized one billion people; diseases that have been and continue to
be neglected by research and that can be prevented or cured with relatively simple interventions [46-50]. These “bottom billion” live in the world’s most economically stressed, population-dense, environmentally degraded areas of the world that are generally underserviced by health systems and infrastructure; a perfect storm for the epidemic spread of dengue to new human populations and geographic areas (emerging infectious disease) and for increasing incidence, prevalence and frequency of outbreaks in already endemic areas (re-emerging infectious disease) [15, 49, 51].

Because of its NTD status, DF falls under the research and development umbrella of the Special Programme for Research and Training on Diseases of Poverty (TDR) funded by the World Bank, UNDP, UNICEF and WHO. Large-scale initiatives within TDR have been created and undertaken with the singular focus of dengue: a Scientific Working Group was created to address dengue in the WHO South East Asia Region, a current joint initiative between the International Development Research Centre of Canada (IDRC) and TDR is addressing dengue in the WHO Latin America and Caribbean Region, TDR Business Line 5 for Innovative Vector Control Interventions also supports a number of dengue prevention and control projects [21, 52, 53].

The three-year project “Meeting capacity-building and scaling-up challenges to sustainably prevent and control dengue in Machala, Ecuador” was funded in 2010 by the TDR-IDRC research initiative on Innovative Community-based Ecosystem Management Interventions for Improved Dengue and Chagas Disease Prevention in Latin America and the Caribbean. This project is part of a larger effort within TDR to support the use and further the development of the Eco-Bio-Social (EBS) approach to vector-borne disease prevention through establishing a multi-country community of practice in the Americas. The joint Ecuador-based project is a comparative study that uses a randomized-controlled cluster trial to evaluate two different approaches to dengue control programming in Machala: a participatory approach to dengue prevention focused on education,
vector breeding source elimination and community involvement is compared with a reactive, insecticide-based program. The current EBS-Ecuador project is based on two successful pilot studies and represents a second step in the scaling-up process of participatory dengue prevention strategies in Machala. It therefore holds an overarching objective to investigate the effectiveness and feasibility of applying an ecosystem approach to prevent and control dengue and facilitating its scale-up to the civic level in a vulnerable endemic setting marked by infrastructural weaknesses and recent large-scale outbreaks and epidemics [54].

EcoHealth, EBS and other integrative participatory approaches allow interdisciplinary and intersectoral teams to develop innovative solutions to local problems that are often just as effective, or more so, than conventional solutions. A major criticism, however, is that these projects and outcomes are only relevant to the local (specific) context in which they were developed [55, 56]. Scaling-up local success with participatory and community-based dengue prevention programs poses significant challenges with changing contexts specific to neighbourhoods, sectors, districts, municipalities, provincial and national geographies. This complicated process requires inventive KT strategies to support stakeholders in integrating knowledge from unfamiliar disciplines, sectors, fields of expertise and personal experiences in order to make decisions.

1.3 Research problem and research questions
The effects of social determinants of health and macro-scale phenomena, such as globalization and urbanization, on dengue and other neglected diseases have been explored by researchers as crucial to understanding and addressing the persistence and re-emergence of many neglected diseases in low-resource settings [57, 58]. The WHO Commission on the Social Determinants of Health (CSDH) represented both a culmination of years of increasing interest and work in these areas, and a turning point in the mainstreaming of these ideas and approaches [59]. The CSDH report was also a call to action on the part of researchers, funders and government entities to implement projects and
programs to promote health equity on a large scale. In this respect, the role of social science and qualitative research in addressing health equity and neglected diseases has been solidly established, even within the relatively restrictive conception of causal pathways in mainstream epidemiological theory and practice. The disciplines of social and critical epidemiology, most prominently developed and practiced in Latin America, present a stronger and more clearly articulated challenge to these linear relationships of causation that systematically exclude considerations for production of health and harm through the effects of social, political and economic structures on quality of life and well-being of individuals, communities and populations [60, 61].

Addressing systemic barriers and bridges to health equity and neglected disease prevention and control without a clear understanding of the complexity of social, ecological and political environments at the local level may negatively affect the sustainability, appropriateness and effectiveness of interventions [58]. There is a historical lack of focus on exploring the connections between the individual, household, community and governmental social spheres, and how the complexity of those connections affects the process of addressing health issues within the current public and global health paradigm [57, 62]. We ought to explore the different relationships, contexts and dynamics particular to each stage of this process, from problem definition, to program design, implementation, evaluation, and scaling-up of successful interventions [63, 64]. Scale-up efforts of local successes in EcoHealth-style interventions are often frustrated because of timelines and funding insufficient to support this kind of qualitative social research necessary to support the development of KT models and guiding principles for participatory practice [65]. This study begins with the broad objective of better understanding the social, cultural and political context of participatory dengue prevention and control programs in Machala and how each of those contexts may influence evaluation, knowledge translation and research-to-policy processes.
The overarching goal of the EBS-Ecuador project to “meet capacity-building and scale-up challenges” in the context of participatory dengue prevention in Machala, fully acknowledges that there are challenges to the operationalization and institutionalization of EBS and EcoHealth-style public health initiatives. Further, these challenges are particular to time, place and space, and require attention to maintain integrity and effectiveness of already established, local, smaller-scale success over extended temporal and geopolitical scales. In order to meet the challenges, they must be situated within the particularities of social, political, cultural and economic dynamics that determine their nature. This thesis thus aims to shed light on some of these dynamics and their complexities in the context of dengue in Machala; to propose tools intended to facilitate the consideration of the same dynamics through current and future implementation, evaluation and scale-up cycles as they pertain to community-based dengue prevention and control; and on this basis, to consider opportunities for further reflection and investigation. In this regard, the wider research question that I address can be characterized as follows:

How do current knowledge management strategies limit equitable participation and where are there opportunities to change?

To investigate this proposition, the specific research questions adopted in this study were:

1) Who are the stakeholders involved in and affected by participatory dengue prevention and control programs in Machala and how do they interact within that context?
2) How do the interactions between stakeholder groups and the perceptions they have of one another affect evaluation, knowledge translation and research-to-policy processes?
3) Are new tools, strategies and models required to support more equitable evaluation and knowledge translation processes? If so, what do they look like?

1.4 Significance of the study
This study intends to provide insight into the social, cultural and political context of participatory dengue prevention and control programs in Machala through participatory
process. There is significant theoretical emphasis on the importance of social determinants of health, however, practical considerations for investigating social factors contributing to the persistence and resurgence of neglected diseases still lags [66]. This work seeks to emphasize the transformative potential of investing earnestly in social science research as part of a more holistic approach to addressing challenges in dengue prevention. Rather than an “added value” aspect, social sciences research exploring specific contexts that produce dengue risk should be an integral element that drives, along with ecological and biological elements, the research to policy process, program design, implementation and evaluation. This study carries implications, both theoretical and practical, for knowledge translation with respect to community health and neglected diseases, and for participatory evaluation praxis.

In particular, the research described in this thesis serves as a practical step in a larger feasibility and scale-up study. The scope of this research is specific to supporting the scaling-up process of the EBS-Ecuador project in devising knowledge translation strategies and evaluation tools that reflect the experiences, concerns and goals of involved stakeholders; it is not intended to assess or document the evaluation and scaling-up processes themselves. The methods, results and outputs provide a working example of participatory process facilitating the systematic inclusion of experiential and tacit knowledge alongside technical and quantitative knowledge, enabling the integration of strong focus on exploring social determinants of dengue transmission risk into the overall research-to-policy process. The methods and findings of this thesis also challenge the accepted decision-making hierarchies of research and policy. Invoking the principles of participatory action research, social justice and health as a human right calls into question the power imbalance with respect to agenda setting, budgeting, timelines and knowledge valuation schemes.

1.5 Overview and organization of the thesis
The organization of this thesis reflects the participatory nature of the research it describes; theories, methodology and results evolve through a spiral of collaborative exploration of issues and challenges as they pertain to the evaluation and scale-up of participatory dengue prevention and control programs.
in Machala, Ecuador. Building from the experiences of the pilot projects, this thesis intends to address the research problem and research questions identified in section 1.3.

Chapter 2 provides theoretical framing and general context for chosen methods and study design. Dengue fever, its persistence, resurgence and changing epidemiology in Ecuador provide the overarching impetus for this study. The history of dengue transmission in Latin America and Ecuador offers insight into biological, ecological and social factors that determine current dengue risk and transmission in Machala. An examination of the literature on social determinants of health lays a foundation for the importance of inclusion of social analysis and social science in health research, particularly for neglected diseases as illustrated by the case of dengue. Reviews of the theoretical underpinnings and literature on EcoHealth and Eco-Bio-Social approaches, knowledge translation and participatory indicator development frame the methodological decisions and discussion in Chapter 3.

Chapter 3 of this thesis provides a more focused overview of chosen methodologies and their appropriateness with specific reference to undertaking research on dengue participatory dengue prevention and control programs in Machala, Ecuador. Mixed methods provide a pragmatic overall approach to the design of a methodology that is rigorous without being exclusive; combining quantitative and qualitative data collection and analysis methods has facilitated the more nuanced ways of understanding, exploring and working within the complex issues, dynamics and relationships related to this research. A focus on equitable participation and the social determinants of health demands intentional consideration of the local context as an axis around which methodological development should revolve. Ethnography and interpretivist inquiry are the underlying drivers for the more specific social analysis and participatory indicator development methods. Ethnographic observation, meetings, interviews, focus groups, surveys, questionnaires, and both qualitative and quantitative analyses
are laid out as the plan to address the research questions described in section 1.3.

Chapter 4 addresses the specific research question regarding the identification of involved and affected stakeholders, and how they are connected to and interact with one another. I explore the social network as it pertains to participatory dengue prevention and control in Machala, as well as some of the social and cultural dynamics that affect the relationships between stakeholders in that network. The social network map and analyses paint an overall picture of the structure of the network as well as of stakeholder relationships. The results presented in this chapter also begin to address the second specific research regarding how the attributes or qualities of the interactions between stakeholder groups and the perceptions they have of one another affect processes related to participatory dengue prevention and control in Machala. The character of the network and of identified relationships are contextualized through illustrative vignettes that describe the complex nature of negotiating equitable participatory work with diverse stakeholder groups in a setting marked with restricted resources, patchy infrastructure and intense public health burdens. These findings inform the participatory indicator development process described and discussed in the next chapter.

Chapter 5 focuses on evaluation strategies and tools with the objective of supporting the EBS-Ecuador project in its policy recommendation and scale-up process. Building on the findings of Chapter 4, the results presented in this chapter continue to explore the ways that stakeholder interactions and perceptions influence evaluation, knowledge translation and carry implications for anticipated scale-up processes. Participatory indicator development combined with principal component and hierarchical clustering analyses are used to develop an evaluation tool, which is proposed and explored in the context of comparatively evaluating two treatments in the EBS-Ecuador project. The development of this new tool and a guiding KT model address the third specific
research question regarding the potential need for new tools that facilitate more equitable KT and evaluation processes. The KT model is constructed based on the combined findings of the social network analysis, ethnographic observations, and its employment in the research-to-policy process and the international global health research system.

Chapter 6 summarizes the arguments and findings of this thesis and explores their implications for dengue prevention and control research, programs and policy. I then use these findings and the implications they carry to challenge current macro, mid and local level knowledge management strategies. Opportunities for improved equity in knowledge valuation schemes, KT and evaluation processes, as well as anticipated scale-up, policy-recommendation and policy-making processes may exist at the interface of equitable knowledge translation and social determination.
Chapter 2 – Foundations of the Study

Dengue fever as a vector-borne viral disease is a human health problem situated at the interface of social, ecological, biological, political and historical forces. This chapter explores some of the history and narrative of the emergence and re-emergence of dengue virus transmission in the social, political and ecological context of Latin America and specifically, in Machala, Ecuador. Importantly, the specific experience of dengue in Machala is a product of local, regional and global forces alike; the latter half of this chapter explores the nature of these forces and proposes the application theoretical frames, research approaches and methodological processes useful to working with and addressing them.

2.1 Dengue fever in Latin America

Genetic marker analyses of pupae and larvae in domestic containers as well as dispersal studies have shown that, although it is capable of traveling longer distances, *Ae. aegypti* mosquitoes rarely feed or oviposit further than 150 m from the site of adult emergence, often returning to that same site and surrounding sites [23, 67, 68]. Scarcity of oviposition sites drives gravid *Ae. aegypti* mosquitoes to disperse greater distances to lay their eggs, however, they always remain inextricably linked to human populations and human migration patterns [69]. The movement of people and goods globally coupled with the close association of *Ae. aegypti* to human populations have facilitated emergence and resurgence of DENV worldwide [70, 71].

As the global incidence of severe dengue increased during and just after WWII, political will and funding were focused on *Ae. aegypti* eradication campaigns. These campaigns were launched largely in response to epidemics of Yellow fever, but because *Ae. aegypti* transmits both dengue virus (DENV) and yellow fever virus (YFV) (closely related flaviviruses) they were effective against dengue as well [44, 72-74]. Vector control programs of this era were vertical in nature and mainly depended on spraying insecticides such as DDT into the homes and...
environment of the affected human populations. These efforts in the Americas were initially very successful in reducing vector populations and interrupting DENV and YFV transmission. Many countries in the Americas officially proclaimed they had eradicated the Ae. aegypti vector within their borders [75, 76]. As a result of their success, the programs in the Americas were thought to have become redundant and disintegrated through neglect or were eliminated by governments in the 1970s [72, 77]. In addition, DDT was banned in the United States of America in 1972 removing political and legal support for these campaigns [77]. By 2001, Ae. aegypti had re-invaded geographic areas it had historically inhabited and had spread into new geographic areas [44, 72-74, 78-80]. This explosive re-emergence of dengue and dengue vectors in the Americas, the result of dependence on defunct state-driven vertical programs, has motivated the current conscious shift in prevention and control strategy toward community-based and/or participatory programs [43, 70].

Locations that have thriving and growing vector populations also have thriving and growing viral transmission [72]. The 1980s brought explosive outbreaks and epidemic spread of dengue throughout the Americas, the number of countries reporting DENV cases worldwide grew to over 100 from 9 in the 1950s [72, 80-82]. Dengue had been commonly accepted as a childhood illness in Southeast Asia since before WWII, but the resurgence of DENV has seen it become a leading cause of childhood mortality in both Southeast Asia and the Americas [72, 73, 80, 83, 84]. Although DENV is endemic in Africa, African DF/SD epidemics are reported far less frequently. This is likely due to poor DENV surveillance, lack of accessible laboratory testing, and reporting in the area as well as a large burden of other diseases, particularly malaria, that often take precedence in the African context and is perhaps not indicative of lower DENV transmission in the region [71].

In the Americas, a DENV-1 pandemic occurred from 1977-1980. The over 700,000 reported cases of DF were distributed throughout the Caribbean, Northern
South America and Mexico. The arrival of DENV-2 caused a SD outbreak in Cuba in 1981, whereas DENV-3 disappeared from the Americas in the late 1970s only to reappear again in 1994. DENV-4 was also introduced to the region via the Caribbean in 1981 and quickly spread throughout the area [73, 80, 85].

The rapid emergence of DENV and hyperendemicity in the Americas has resulted in a changing DF/SD epidemiology, and has brought attention to the changes in its epidemiology worldwide. DF and SD are primarily diseases of adults in the Americas whereas they have traditionally been considered pediatric diseases in Southeast Asia [86]. All four serotypes have been found in Southeast Asia since they were first isolated and identified during World War Two, and as a result it was believed that the epidemiological patterns for DF/SD were stable in this region. More recently an increasing proportion of reported cases in both Southeast Asia and the Americas are afflicted adults [80, 84]. The improved clinical definitions of DF, SD and DSS as well as improved diagnostics, surveillance through public health systems and primary care delivery for infected persons may be playing a role in the increased number of reported cases in adults. DF/SD are difficult to distinguish from other febrile illnesses where a lack of resources restricts technical diagnostic capacity and the historical emphasis on hemorrhagic symptoms to diagnose SD resulted in skewed clinical surveillance [87].

Global and regional-scale serotype emergence and vector infestation do not relay the more nuanced experiences of populations affected by this emerging and resurging disease within regions. Dengue incidence continues to rise within regions and new countries and geographical units within countries continue to report first cases and first epidemics of DF/SD [86]. Bhutan reported its first cases of DENV infection in 2005, Nepal’s first DF outbreak was reported in 2006; North Korea is the only country in the WHO Southeast Asia region (SEA) not reporting indigenous DENV transmission [86]. The first outbreak of DF caused by indigenous DENV transmission in Chile was reported in 2002, DENV-1 was isolated from the patients [88]. DF/SD outbreaks/epidemics in both regions follow
a cyclic pattern of outbreaks every few years involving thousands of people with lower-level endemic transmission sandwiched between. An alarming pattern has been documented in the Americas whereby DF epidemics are followed by a three to four year low-level endemic transmission period that leads into a 2-3 year epidemic transmission period. Of particular concern is the escalating severity of the 2-3 year epidemic periods, progressively higher incidence has been observed in latter cycles [89]. Epidemics normally originate in large urban centres marked by high human population density and weak public infrastructure (sanitation services, reliable municipal piped-water supply) and spread outward to smaller centres [86].

2.1.1 Dengue in Ecuador
Globalization has had profound effects on Ecuador in terms of industry, agriculture, human and environmental health, and political, social and health systems [70, 90]. Weak health and social systems in Ecuador are continually eroded by the influence of structural adjustments imposed by the crushing debt the country carries to the International Monetary Fund (IMF) [90, 91]. In a country where glaring health and economic inequity exist, neo-liberalist trends in policy and programming have led to increased rural poverty, progressively poorer access to health care and environmental degradation which has, in turn, contributed to urbanization.

Ecuador’s history of epidemic yellow fever led to participation in the widespread Ae. aegypti eradication campaigns and the elimination of the vector in 1958 [91]. The resurgence of the vector has allowed DF to emerge as a major public health issue in Ecuador along with other vector-borne diseases. Today, Ecuador is endemic for DENV-1, 2 and 4 with its first outbreak of DF in 1988. Over 800 000 people were affected by the DENV-1 epidemic in Guayaquil, epidemic cycles continued throughout the 1990s and through the early 2000s registering approximately 3 million cases to date [92]. An outbreak of DF/SD occurred in 2003 with 10 726 cases of DF and 206 of SD [92]. In 2010 there was a dengue
epidemic in El Oro from mid-January to April with 3365 cases of classic dengue fever and dengue hemorrhagic fever. Machala proper registered 1474 dengue cases. Pasaje, Guabo and Santa Rosa, all within 20 minutes of Machala, registered a combined 1408 classic dengue cases [91]. Ecuador has seen a steep increase in the overall number of dengue cases over the past few decades [54]. The epidemiology, geographic distribution and seasonality of dengue are changing through ecological and climatological effects on vector populations [93-95]. Links between climate change and vector-borne disease in Ecuador have emerged as priorities for government programming and investigation as well as government-university research partnerships [96]. While cases and outbreaks of DF/SD are anticipated in the larger coastal urban and peri-urban areas of Machala (El Oro), Guayaquil (Guayas) and Huaquillas (El Oro), cases of DF are now being found in the smaller cities of Zaruma and Portovelo in southern highlands of El Oro that were previously considered outside the ecological and geographic region of Ae. aegypti [94].

Vector control in Ecuador is done through a vertical body of the federal government, the National Service for Control of Vector-borne Disease (SNEM), and is primarily an insecticide-based responsive control program based on epidemiological and entomological data. As cases of DF/SD are identified by the primary health care system, epidemiological data is transferred to the vector control branch that dispatches a fumigation team to the residence of the reported case. Inspection for larvae, pupae and adults on the premises is done, indices are recorded and the interior, exterior and surrounding grounds of the house are sprayed with insecticide and larvicide is used to control standing water. Depending on seasonality and measured DENV transmission risk, the surrounding houses and their grounds are also sprayed with insecticide [94]. This vector control program is linked strongly with the primary health care system and with health promotion activities within the decentralized health units. Social mobilization is used often and is effective in improving health outcomes and positively impacting risks for many different diseases [97, 98].
Ecuador suffers from a shortage of skilled human resources for health and research capacity. Weaknesses in health systems and the capacity to evaluate programs and generate innovative vector control strategies have been targeted by recent efforts to build health research capacity and to empower communities to become involved in health training and decision-making [97, 99, 100]. These projects have helped to introduce the new paradigm of EcoHealth; a focus on human health as the product of the environment, social and political structures that one lives within and of human behaviour [101]. This new capacity for vector-borne disease prevention and control research with the new focus of EcoHealth is accordingly well positioned to facilitate a social-ecological approach to vector control innovation [58, 99, 100, 102, 103]. By linking with the established and ongoing achievements of the Latin American “salud colectiva” initiative, such pursuits can be especially sensitive to considerations of health equity in conditions of great disparities [101].

These new trends in developing capacity in health research and strengthening health systems are opportune in that they coincide with a change in political will in Ecuador. The ratification of the New Constitution of Ecuador in 2008 has created a shift in priorities toward placing more importance on human health, quality of life and the health of the natural world (Pachamama) [60, 104]. Ecuador has opened a policy window in which political support and attention are currently focused to a far greater extent on non-medical factors that affect health; environmental degradation, education, health systems, human rights, food and water security.

The challenge to Ecuador in the domain of dengue is well illustrated by the relatively successful examples of Cuba and Thailand that feature intersectorality and a focus on social determinants of dengue transmission risk [14, 105-111]. Cuba, on the other hand, has had impressive successes when dealing with both epidemic and endemic DENV transmission. This has been attributed to the
overarching focus that the Cuban government has maintained on improving health for over 50 years and, as products of that focus, an incredible wealth of skilled human resources in health, strong and integrated health systems, great health research capacity and decentralized health service delivery systems that focus on social mobilization [112-115]. Even with limited economic resources, Cuba has been able to successfully manage DF/SD within its borders by implementing Cuban-style integrated vector management and promoting community ownership of DENV environmental risk management [116]. Thailand has strong primary health care and reporting systems backed up by a robust diagnostic infrastructure with links to military institutions and research [106, 117]. This electronic reporting system is housed within the Division of Epidemiology of the Ministry of Public Health relays information about DF/SD cases directly from patient records to epidemiological databases for analysis and dissemination of information through the Thai Ministry of Public Health [107]. Recent IVM projects with community involvement in implementation are based directly on the results of in-country research on the changing epidemiology of DF/SD, and showing that school-aged children are the most important age group for SD in Thailand, insecticide resistance is reducing the effectiveness of chemical-based prevention, the need for a social-ecological component in DENV control programs and that epidemics occur during the rainy season [106-108]. This uptake of evidence and implementation of recommended solutions has shown reduced vector indices and incidence of DF/SD in treatment areas as compared to control [118]. An even more recent multi-country study, which included a Thailand-based study, has shown that interventions with ecological, biological and social components are far more effective at reducing DENV transmission and risk than those without [108, 119]. Integrated vector management should be incorporated as part of an intersectoral effort to combat dengue through the reduction and/or elimination of environmental and social DENV transmission risks [120]. Focusing on the already established strength for social mobilization, Ecuador is pushing toward social empowerment through training and capacity building for a genuinely bottom-up and participatory evidence generating process.
It remains to be seen whether the policy window has opened wide enough or will stay open long enough for this burgeoning body of in-country research to affect vector control policy and program implementation.

### 2.2 Social determinants and social determination of health

Definitions of health have moved from a static biomedical idea focused on the presence or absence of a disease in the human body, to a systems-based concept including the production of health through systems and forces that act on and interact with human populations. This systems vision stresses the importance of examining upstream influences on health; global, macro, regional and local forces determine the context for human health at various levels through the influence of political, social, cultural, economic, environmental and resource systems [104, 121]. Social determinants of health (SDH) have become more prominent in public health, international health and global health research following the publication of the Report of the WHO Commission on Social Determinants of Health in 2008, which describes and examines SDH within the frame of social justice, health inequity and health as a human right [122, 123]. Evidence abounds that impoverished, marginalized and stigmatized populations have lower health indicators, lower quality of life, higher morbidity and mortality than populations who enjoy at least the basics of human security, a higher socioeconomic status, and higher political and social agency. Unfortunately, increased evidence and awareness of SDH have not necessarily translated to advances in addressing them through policy mechanisms [59].

The social justice frame drawn around these health inequities, interrogates the static concepts of poverty, stigma and marginalization. Rather than understanding these immensely complex dynamics as labels or fixed qualities of populations, they should be considered as mechanisms through which oppressive systems deprive human beings, both individuals and communities, of their basic human right to health. Health inequities are created by the disproportionate allocation of resources, power, services, security and agency
that pervades nearly every level of human organization. Global trends in health inequity are replicated at the regional, national, state and municipal levels all over the world; policies and programs at every level participate in the creation or determination of structures and circumstances that damage the health of human beings. The Commission on Social Determinants of Health outlines three principles of action to improving health equity through addressing SDH: improving the conditions of daily life, confronting and changing the systems that produce and perpetuate the unequal distribution of resources, power and services, and creating skilled human resource capacity to address SDH through action, monitoring, reporting, awareness and sustainable change. These gargantuan tasks carry the weight of hundreds of millions of people. Reference to neglected diseases and marginalized people is increasingly frequent in global health rhetoric, as is work centered around “the bottom billion”, which as discussed in the Introduction, highlights the desperate and urgent situation that continues to intensify through neoliberal and extractive policies still relied upon to drive trade, economic growth, land-use and service provision world-wide.

Undertaking research and development works focused on SDH adds the dimension of social justice to the design, execution and evaluation processes for new health interventions. Holding an overarching and long-term goal of improving health equity is important to the necessary reorientation away from short-term easily measurable outcomes and deliverables, and toward a less immediate, difficult to measure, but perhaps infinitely more valuable social change at multiple levels of human organization and governance. This may imply a re-definition of success, objectives and timelines; rather than short-term, superficial interventions, we ought to be working toward comprehensive interventions that address the policies programs and practices of all sectors that converge to produce and sustain complex human health issues. Working toward health equity through addressing SDH should include, regardless of the issue at hand, considerations for examining governance, power dynamics, human security and political agency of affected people and addressing upstream inequities in the
distribution of power, resources and services that contribute to local problems. This work should be action-oriented; rather than producing evidence to be “taken up” by decision-makers that are steeped in oppressive policies and systems that perpetuate inequity, evidence must be generated in an equitable way such that it may be brought to bear on political processes, governance and decision-making.

Frameworks such as the WHO-developed DPSEEA (Driving force, Pressure, State, Exposure, Effect, Action) framework help to clarify the scope of health issues and provide a working context for such interventions [121, 124]. Driving forces are macro-level dynamics (policies, globalization, industrial trends) that produce specific pressures on physical, social, political or cultural environments (patchy basic and sanitary infrastructure, rapid urbanization, use of plastic packaging), which in turn create a particular state of being or context for a health issue (stored water for domestic use, peri-urban poverty and sub-standard housing, environmental pollution with plastic containers). The interface of daily human existence with the macro-level forces is explored through exposure to a health risk (Ae. aegypti production within the home, lack of physical barriers between infected dengue vectors and susceptible people, abundance of vector breeding habitat in the community space), and effect explores the immediate experience of illness or damaged health of affected people (high dengue transmission risk, vector indices, and dengue incidence).

The vision of the DPSEEA framework specifically encourages consideration of possible intervention actions at all levels. Moreover, the traditions of social and critical epidemiology encourage a challenging of linear concepts of health, disease and causation to consider macro-level phenomena affect the local context. Social determination especially posits health (or the lack of health, that is harm) as an object produced or determined by the power structures of a society [61, 122]. Structurally violent society denies human beings the basic necessities of life, including health, through its political and economic organization, institutions, and the imposition of oppressive social arrangements [125]. Because
both social determination phenomena and structural violence are deeply
engrained within dominant worldviews, they are ubiquitous, pervading nearly
every aspect of human society. Insidiously, their ubiquity renders them less
visible to the uncritical observer, which in turn contributes to the erroneous
perception that they are less actionable [61, 126]. The theory of social
determination emphasizes the importance of a paradigm shift in addressing
health inequity at the local, regional, national and global levels; the power
structures that perpetuate violent social arrangements are replicated at every
level [126]. Without the frame of SDH and understanding that health is produced
by a wide range of interconnected dynamics that must be addressed, sustainable
solutions to complex health problems like dengue will continue to elude us.

2.2.1 The importance of SDH in dengue prevention and control
Unlike the majority of the neglected diseases (ND), dengue fever and severe
dengue (DF/SD) are considered primarily urban diseases [48, 60, 70]. *Aedes aegypti*
biology and dengue virus (DENV) transmission dynamics in a densely-
populated urban setting provide the foundation for epidemic spread of DF/SD
spilling into sub-urban and rural communities as well. The key to DENV
transmission is having a dense susceptible human population in the same
endemic geographic area as a dense vector population with spaces for these two
populations to interact. Urban environments lacking in public services, sanitation
(addressing greywater, sewage and solid waste or refuse removal), piped water
and/or reliable domestic water supply, with poor housing, lower socio-economic
status and poor access to primary health care and health education provide
ample social and environmental spaces within which susceptible human
populations are exposed to infected vector populations [46, 48, 70, 127, 128].
Humans and their spatial and social associations influence DENV transmission
patterns [30].

Dengue and its associated mortality are essentially a problem of domestic
sanitation, water security, quality of housing and access to primary health care;
all “local” issues that are exacerbated by the macro-level phenomena of
globalization and urbanization [72, 78, 129]. Human health is a product of the social, political, economic and environmental forces that act on a given person, family, community or population [49, 59, 102]. Globalization, a process by which national and regional economies are linked through the production and consumption of goods and services, is changing the social, political and economic structures and processes that affect human health in the developing world [91, 130-132]. It is an exploitative force that further marginalizes the most impoverished nations and people, funnels resources away from them and carries deleterious health effects [91, 133].

Globalization of economies and production-consumption dynamics has influenced human migration and settlement patterns through the concentration of economic opportunities in urban centres. Urbanization is the rural-to-urban migration trend whereby rural populations are forced to seek employment in urban centres because of rapidly increasing economic insecurity in rural areas [127, 134, 135]. These pressures combined with the global overpopulation crisis have resulted in a shift from 36% (1.33 billion people) of the world’s population living in urban centres in 1970, to 44% (2.42 billion) in 1994 and a predicted 61% (4.6 billion) in the year 2025 [127, 130, 135]. Much of this exponential population growth and urbanization is taking place in developing countries putting incredible strain on health systems, public infrastructure and the environment [136, 137]. Rapid uncontrolled or unplanned urbanization produces impoverished, overcrowded urban neighbourhoods and populations with inadequate, little to no sanitation, little to no access to a secure supply of safe water or to primary health care and that are politically and socially marginalized [59, 130, 137].

The effects of globalization and urbanization shed light on an important distinction that should be made when addressing neglected diseases (ND). The term ND is used to refer to a disease that has been neglected by funding, research, health innovation and development of pharmaceutical intervention. This may be the case, however, a far more important aspect of NDs is that they
primarily infect neglected populations totaling billions of neglected people [48, 49, 130, 138]. The biomedical and positivist research paradigms have fostered linear thinking regarding disease causation, that a person is ill or infected because of the presence of a pathogen or physiological dysfunction within their body. It does not address the underlying determinants, social dynamics or structural processes that perpetuate the illness or infection within the community the ill or infected person belongs to [46, 59]. NDs should be considered neglected diseases of neglected populations [139]. Looking at human health as the product of all of these factors may provide solutions to the DF/SD problem that vertical insecticide-based programs cannot.

As with disease and health inequity, there are macro-level determinants affecting the political will, resources and pressures to address and pursue solutions to these problems. The 17 diseases classified as “neglected” are old diseases that the same populations have struggled with for centuries. The designation of “neglected” is relatively new and is a part of a movement building momentum toward addressing these long-standing problems with research, development, innovative interventions and new delivery strategies [140]. This new push toward addressing NDs and their determinants is the synergy of key movements in funding, awareness and political will at the international level over a span of many years. In 1976 the Special Programme for Research and Training in Tropical Diseases (TDR) was created by the WHO, UNICEF, World Bank and UNDP to specifically address diseases of poverty [48]. This was closely followed by the Alma Ata declaration of 1978 in which the WHO declared that health is a human right and not just defined by the absence of disease. Rather, it posed health as a physical, mental and social state of well-being that requires participation from the people, multiple economic and social sectors in concert with the health sector. The Alma-Ata declaration saw a strong, intersectoral primary health care system as the main means to improving human health with a long-range goal of improving world peace through better human security [47]. This set the stage for a more significant focus on global health, addressing the
needs of marginalized populations (women, children, poor) and a movement toward an integrated approach to human health intervention and health care delivery.

Dengue is a persistent public health crisis in Ecuador, a country that began a political shift toward a more holistic approach to human health, governance and intersectoral collaboration with the creation of its new constitution in 2008. Sustainable solutions with the long-term vision and wide scope required to address the complex issue of dengue will be frustrated without examining the full spectrum of social and cultural determinants of health that it comprises. Local, equitable, participatory, short-term successes in dengue prevention and control will wither through the scaling-up and institutionalization process without specific consideration for the political and social driving forces of the disease.

2.3 The EcoHealth approach and the Eco-Bio-Social paradigm
Intricate relationships linking human health, macro-level forces and non-medical determinants require research approaches that facilitate the wide consideration of global threats to human health through local-level action-oriented inquiry. EcoHealth and Eco-Bio-Social approaches attempt to address these challenges, with encouraging results in recent years [1, 62, 64].

An ecosystem approach to human health, or EcoHealth, has gained momentum within the vector-borne disease research and control community [109, 111, 119, 141-144]. Stated eloquently by Dr. Mariano Bonet, “The EcoHealth approach recognizes that there are inextricable links between humans and their biophysical, social and economic environments that are reflected in an individual’s health [58].” EcoHealth is based on the idea that improved human health will result from better understanding of the determinants of health and the societal response to those determinants [102, 139, 143]. In other words it sets up a feedback loop of research and action with the question of “What produces good or poor health?” on one side and the responses of society (i.e. environmental modification, policy, changed behaviour) to the answers of that question.
generated through research (Figure 3). In essence EcoHealth is a challenge to researchers to identify opportunities to improve human health and then test and refine strategies that address those opportunities [102, 139, 143].

![Iterative research/action loop proposed by EcoHealth incorporating determinants of ecosystem and human health and societal responses to opportunities to improve human and ecosystem health (adapted from Forget 2001) [143].](image)

The definition of the ecosystem as used by EcoHealth, posits the ecosystem as an analytic concept with many layers of interdependent elements, each having influence over the other through their interconnectivity [102]. EcoHealth is integrative in that it considers management of the physical environment, economic factors and community aspirations or socio-cultural factors to be of equal importance; that human health is a product of the equal interaction of all of these factors [102, 143, 145]. These elements comprise EcoHealth’s analytic concept of the ecosystem, with the physical environment further subdivided into home, neighbourhood, urban, regional, national and biosphere environments (Figure 4) [102, 146].
Figure 4 - The EcoHealth analytic concept of the ecosystem presenting human health as a product of the physical environment, socio-cultural factors and economic factors linked throughout the “nested” layers of the surrounding environment (adapted from Forget 2001) [145]

The theme of sustainability is built into the EcoHealth model through the inclusion of human beings in the ecological paradigm and striving to promote sustainable development of human communities: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [102, 143]. Environmental and long-term intervention sustainability resonates well with the dengue-control research community, as there is a push toward community-based solutions and away from vertical insecticide-based programs. Similarly relevant is the tenet that stakeholders within the EcoHealth community of practice should include three groups: researchers and specialists, community members and decision makers; all working supported by three methodological pillars: transdisciplinarity, participation and equity [87, 147]. All of these are important to the effectiveness and sustainability of dengue control and prevention programs [102, 143, 148].

The EcoHealth approach to dengue control has been successful at the local level and shares common methodologies and a theoretical basis with the Eco-bio-
social approach [56, 102, 109, 111, 143, 144, 149-151]. Although the Eco-bio-
social approach does not specifically hold equity (gender equity in particular) and
participation as “methodological pillars”, the two approaches are often linked in
practice and are sometimes used synonymously [122]. These control efforts must
incorporate an ecological element (i.e. environmental impact of control efforts,
ecologically sound control measures, an ecological approach to human health), a
biological element (i.e. mosquito control, use of entomological surveys and
indices, human health and clinical data), and a social element (i.e. knowledge,
attitudes and practices of at-risk human populations, communication strategies
and perceptions of stakeholder groups, social effects of control programs on
human populations) [119, 144, 152].

2.4 Introduction to knowledge translation
Research approaches to address complex health issues require interdisciplinary
and intersectoral collaboration, stakeholders with experiences and knowledge
that speak to the diverse fields of social, environmental and political determinants
of health. Action-oriented approaches also require that these diverse
stakeholders can collaborate in practice as well as theory; this requires strategies
to share, mobilize, apply and evaluate the use of knowledge. I propose
knowledge translation as a broad mechanism to support this collaborative praxis
and to provide a foundation to address my overarching research question: How
do current knowledge management strategies limit equitable participation and
where are there opportunities to change?

2.4.1 History & theoretical roots of knowledge translation
Knowledge Translation (KT) as a construct is relatively new to the health
disciplines, and is gaining in popularity albeit surrounded by much nebulous
rhetoric. It reflects growing attention manifest across various disciplinary and
institutional settings in recent decades for improving connections between
research and practice, that has been associated with a variety of terminologies
[144]. The Canadian Institutes of Health Research (CIHR) conceived the term
Knowledge Translation in 2000 as an innovative and widely encompassing
concept referring to the processes of generating and implementing knowledge in health practice as it relates to clinical practice, public health and health policy & programming [34, 36, 151, 153]. The definition of KT has evolved over the 10 years since its inception; definitions vary according to the disciplines and institutions in which they were conceived. CIHR originally defined KT as “the exchange, synthesis and ethically-sound application of knowledge - within a complex system of interactions among researchers and users - to accelerate the capture of the benefits of research for Canadians through improved health, more effective services and products, and a strengthened health system” [34-36, 154]. CIHR has since adapted their definition to describe KT as “a dynamic and iterative process” emphasizing its multidirectional character [37, 154].

The KT concept in this specific iteration originated with CIHR, so it follows that much of the literature surrounding it is steeped in language of health disciplines and is tailored to clinical practice. There are, however, other institutions and disciplines that are adopting the concept of KT and modifying definitions to suit. The World Health Organization defines KT as an emerging paradigm to learn and act towards closing the know-do gap by employing strategies that can harness the power of scientific evidence and leadership to inform and transform policy and practice [37, 154, 155]. Although the WHO definition of KT is still centered around health it more clearly emphasizes the “action” element of KT through the implementation of knowledge to change policy and practice in multiple contexts [154]. The National Center for the Dissemination of Disability Research (NCDDR) defines KT as “the collaborative and systematic review, assessment, identification, aggregation, and practical application of high-quality disability and rehabilitation research by key stakeholders for the purpose of improving the lives of individuals with disabilities” [156]. The NCDDR definition expands the original further to include not just improving health and health systems, but to improving quality of life of individuals through use of available evidence.
The increasingly popular KT paradigm does not have a well-defined, generally accepted comprehensive conceptual or theoretical framework. Rather, KT practices commonly feature similar goals, assumptions and tools in their operation and thus contribute to the growing body of evidence and experience around KT and the ongoing development of best practices for KT [36, 154, 156].

The belief that policy and practice should be based on the best and most sound evidence available is the core principle of KT. This makes it inherently an action-oriented approach wherein the generation of knowledge is not an end, but is an intermediate step in an iterative process to refine and improve practices that address real-world issues. The concepts of the “know-do gap” and “evidence-based practice” are often invoked in discourse surrounding KT. The “know-do gap” refers to the discrepancy between the practice prescribed by sound, available evidence and the practice that is employed on a day-to-day basis [35, 154, 157-159]. Evidence-based practice refers to tailoring interventions, strategies and service delivery to reflect the most suitable way to address issues, concerns or problems as shown by research evidence [154-156, 158, 159]. The invocation of evidence-based practice in KT discourse points to the important assumption that the “knowledge” referred to in KT is research-derived [37, 156]. This presents a fundamental bias toward the valuing of academic, institutional, peer-reviewed or formal knowledge over types of knowledge held outside the realms of research and formal evidence-generating pathways (i.e. lay, traditional, aboriginal and/or community knowledge) [154].

As defined by CIHR, KT involves the active exchange of knowledge between researchers who create new knowledge and the people who use it [37, 159]. Multiple research users within a complex system of health care and service delivery dictate that KT be a non-linear and interdisciplinary process heavily relying on multi-directional communication strategies. It also implies that KT must be contextual; that the process of KT should facilitate the uptake and application of knowledge by a given user through its presentation in a
contextually appropriate and user-specific manner [33, 158]. For example, new knowledge around domestic violence prevention strategies would be relevant to public health nurses and the community in different ways and should be made accessible and understandable to these different groups accordingly. Each issue brings with it a diversity of stakeholders and stakeholder groups including but not limited to administrators, researchers, communities, individual recipients of care/knowledge, organizers, lay and trained practitioners, governments and government officials at all levels, private sector actors, advocates and advocacy groups, institutions, media, the general public and the public sector. It is important to note that research producers are also research users in this iterative process.

KT emphasizes uptake and application of knowledge by users with the ultimate goal of positive health impact, thus it includes each step of the process from new knowledge generation to knowledge application and impact assessment [33, 37, 154, 160]. Graham et al. (2006) present a 7-step KT model in which knowledge is created, adapted and transmitted for uptake or use in the context of a specific health problem, then followed by a knowledge use impact assessment leading to a new KT cycle [154]. CIHR presents a KT model based on a research cycle in which there are 6 opportunities for facilitating KT [33, 34, 37]. The model identifies these as junctures in the KT process at which collaboration, interaction and communication between knowledge producers and users will promote KT and the generation, uptake and application of knowledge (Table 1). CIHR’s KT model attempts to graphically illustrate a process that includes knowledge dissemination, communication, technology transfer, ethical context, knowledge management, knowledge utilization, two-way exchange between researchers and those who apply knowledge, implementation research, technology assessment, synthesis of results with the global context, and development of consensus guidelines [154].
Table 1 – Comparison of knowledge translation models presented by Graham et al. (2006) and CIHR (2007)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Knowledge creation</strong></td>
<td><strong>Step</strong></td>
</tr>
<tr>
<td><strong>KT Model, Graham et al. (2006)</strong></td>
<td><strong>Step</strong></td>
</tr>
<tr>
<td><strong>Knowledge creation</strong></td>
<td>Process through which major types of knowledge are refined by research to be made more valid useful to healthcare systems.</td>
</tr>
<tr>
<td><strong>Identify problem and review knowledge</strong></td>
<td>Identification of a problem by a group or individual and searching for knowledge or research to address it</td>
</tr>
<tr>
<td><strong>Adapt knowledge to the local context</strong></td>
<td>Decision-making process through which the value, usefulness and appropriateness of particular knowledge to the specific issue, setting and circumstances</td>
</tr>
<tr>
<td><strong>Assess barriers to knowledge use</strong></td>
<td>Implementers assess for potential barriers that my impede knowledge uptake as well as uptake facilitators</td>
</tr>
<tr>
<td><strong>Select, tailor and implement interventions</strong></td>
<td>Planning and executing interventions to facilitate and promote awareness and implementation of the knowledge</td>
</tr>
<tr>
<td><strong>Monitor knowledge use</strong></td>
<td>Defining and measuring knowledge use</td>
</tr>
<tr>
<td><strong>Evaluate outcomes</strong></td>
<td>Evaluate the impact of knowledge use or application</td>
</tr>
<tr>
<td><strong>Sustain knowledge use</strong></td>
<td>Determining the sustainability of the knowledge use</td>
</tr>
</tbody>
</table>

Knowledge translation, in the Canadian context and beyond, is understood to incorporate both end-of-cycle KT and integrated KT; each of which plays a specific role and carries corresponding implications for the research process and equitable participation [37]. End-of-cycle KT (also referred to as end-of-grant) encompasses the activities researchers plan and carry out to make stakeholders aware of innovative and potentially useful knowledge resulting from a research cycle or project [154]. Integrated KT takes place longitudinally over the life of the research process, with stakeholders and other knowledge users involved at each step [161]. While integrated KT by definition incorporates the notion of equitable participation and dynamic knowledge exchange during planning, design,
implementation, analysis and reporting, impact and stakeholder “buy-in” does not necessarily follow [34, 161]. The fields of knowledge-to-action and KT are burgeoning in the health sector and beyond; of particular note are the innovation and attention to context-specific models, social mobilization and health equity [162-164]. Although there are several identified KT models that support public health action to improve health equity, there is still a need to continue to develop and refine KT theory and practice to include a focus on health equity in a more robust way [33]. Models that explicitly incorporate considerations for promoting and improving health equity and social mobilization, recognizing the crucial role of contextual factors in problem solving approaches, and drawing on knowledge from multiple sources are most promising [165].

2.4.2 Knowledge valuation schemes: historical & present
Since the term Knowledge Translation was coined in 2000, it has influenced how health research is done in Canada and internationally [37, 154, 166]. The CIHR KT model is neither a completely novel idea, nor can it be divorced from the social context within which it was created [154-157, 167]. Although these KT models offer new developments and strategies in the research cycle, they still operate within systems that perpetuate conventional value judgments on types of knowledge and equitable knowledge creation. Theoretical and practical precursors to the KT concept have shaped its rhetoric and the way it uses different types of knowledge. There are significant challenges to the notion that KT as defined by CIHR and Graham et al. (2006) can be used as a stand-alone emancipatory action research method to improve human health and quality of life. Without the additional framing through the lenses of SDH, health equity and the inclusive concepts of health embodied in EcoHealth and EBS approaches, KT may not reach beyond its roots in diffusion of innovation and biomedically-oriented evidence-based practice.

Rogers’ Diffusion of Innovation Theory (DIT) conceived in the 1960s has had substantial influence on the development of the KT concept through its pervasive use in knowledge management and transfer theory and practice[35, 37, 156,
Diffusion of Innovation Theory describes and explains the manner in which an innovation or new idea spreads throughout social systems [154, 171]. Specifically DIT looks at how innovative products spread through markets and are adopted by individuals and groups. The theory originated in the realm of technology and marketing and describes four elements that determine the spread of a new idea: 1) the innovation itself, 2) communication channels, 3) time, and 4) a social system [168-170]. In addition there are five characteristics of an innovation that will influence the rate at which the innovative product will diffuse: i) The advantage that the innovation brings to those who adopt it, ii) the compatibility of the new product with the adopter’s experiences and values, iii) the complexity of the innovation and/or how readily the adopters can implement or apply it, iv) the divisibility of the innovation (whether an innovation can be used piecemeal or must be adopted in its entirety), and v) how readily beneficial results can be observed and directly attributed to the adoption of the innovation [170, 172].

Applying this theory to knowledge and the uptake and utilization of knowledge within a group of stakeholders has been instrumental in the development of contemporary KT models. Replacing the new product or innovation with “new knowledge” and superimpose DIT on health service delivery and research systems reveals that the translation of new knowledge into evidence-based practice does not depend solely on the scientific merit or rigor of the knowledge but on how that knowledge is perceived by influential groups within the system over time [168, 170]. Harkening back to the idea of a social system is important here in that the general public and society itself should be included in the health service delivery and research system.

An important aspect of this theory is that it arose from the fields of rural sociology and agricultural economics and was originally written referring to commodity exchange not to a learning organization or health systems [169, 170]. The evolution of modern KT practice from commodity theory leads to a culture that
views new knowledge as a commodity to be traded between producers and users rather than a shared resource [170]. Knowledge as a commodity evokes economic language and theory in knowledge management literature; within that atmosphere knowledge is categorized and value judgments are placed on different knowledge types [159, 172]. Health systems, and by proxy KT literature as it originated in the health field, value research-derived knowledge (often called evidence) over all other types of knowledge[159, 173, 174]. This results in a constricted scope for change and innovation in a field where many different types of knowledge contribute to and sustain human health and quality of life. Evidence is often created in an artificially sterile (experimental design and control) environment that generally overlooks the influence of other forms of knowledge in decision-making processes. Experiential knowledge, personal knowledge and collective/cultural knowledge are not considered as legitimate on the same level as evidence and rarely form the rationale for decision-making[37, 154].

The CIHR KT model, however, deliberately addresses this hierarchical valuation of evidence and knowledge by explicitly stating that new knowledge should be integrated with existing and other forms of knowledge and sociocultural norms and to emphasize that the context of the issue being studied is integral to successful innovation [169, 173, 175]. The context of an issue under scrutiny is often deconstructed into sociocultural norms, local or community knowledge, beliefs, behaviours and practice; the experiential knowledge of the issue as it is dealt with on a day-to-day basis. While it is true that understanding context and the adaptation of evidence to the context of an issue is essential to its translation into action (revisiting the idea that it is the social system that diffuses innovation based on perceptions of the innovation “transmitted” from one individual or group to the next [37, 154, 168], this promotes the idea that context is more valuable as an evidence transmission vehicle than as an important source of knowledge in and of itself.
The health sciences are firmly rooted in the positivist paradigm and have been for hundreds of years. The valuation of research-derived knowledge above other forms of knowledge naturally evolved from these roots as shown by a strong emphasis on evidence-based practice within the health disciplines[169, 170]. At its core, practice consists of decisions made and a course of action pursued based on those decisions. Evidence-based practice (EBP) seeks to have research-derived knowledge or evidence determine how decisions are made rather than tacit, experiential or personal knowledge [169, 173]. The hierarchical valuation of knowledge in EBP decision-making extends further by categorizing types of evidence and assigning levels of “trustworthiness” to each category. There is a general trend in the hierarchy toward increased scientific rigor correlating to increased trustworthiness of the evidence; the systematic review of randomized controlled trials being at the top of the hierarchy (Table 2)[176, 177]. The reliance on increasingly esoteric forms of scientific evidence serves to remove programming, practice and decision-making from the interface between practitioner and the public to the realm of administration and policy-makers[177, 178].

Table 2 – Hierarchical organization of types of evidence that inform decision-making processes in Evidence-based practice from most to least trustworthy[173, 179]

<table>
<thead>
<tr>
<th>Relative strength of evidence</th>
<th>Type of scientific evidence</th>
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<tbody>
<tr>
<td>I</td>
<td>Strong evidence from at least one systematic review of multiple well-designed randomized controlled trials (RCTs)</td>
</tr>
<tr>
<td>II</td>
<td>Strong evidence from at least one properly designed RCT of appropriate size</td>
</tr>
<tr>
<td>III</td>
<td>Evidence from well-designed trials without randomization, single group pre-post, cohort, time series or matched case-controlled studies</td>
</tr>
<tr>
<td>IV</td>
<td>Evidence from well-designed non-experimental studies from more than one centre or research group</td>
</tr>
<tr>
<td>V</td>
<td>Opinions of respected authorities, based on clinical evidence, descriptive studies or reports of expert committees</td>
</tr>
</tbody>
</table>

There have been incredible advancements in the delivery of health services and in public health because of reliance on EBP and sound scientific research[177]. There is international call for the increase of the use of evidence in creating policy, programming and informing clinical practice; it is often coupled with the
notion that a strong health care system cannot exist in the absence of a strong health research system firmly linked to it[52, 99, 178, 180]. At the systems level, EBP can increase accountability in service delivery, reduce variation in care and programming, and improve health outcomes. EBP embodied in clinical guidelines and public health policy and can streamline practice, programming and service delivery, and manage risk effectively by blending the most reliable evidence available with patient preferences (clinical) and/or local context and knowledge (public health)[100, 180]. Evidence based practice and evidence based public health also incorporate reflective practice to evaluate how the decisions made performed in solving problems or positively impacting health issues[155, 160, 180].

The 5 basic steps of EBP are to 1) convert information needs into answerable questions, 2) gather the most reliable evidence available to answer questions, 3) critically appraise the evidence for validity and utility, 4) apply evidence in clinical practice (or public health programming) and 5) evaluate the performance of the decisions made or interventions undertaken [169, 181]. This process has striking similarities to the CIHR KT model in that answerable (research) questions must be designed in the context of a clinical or real-world problem, evidence must be gathered (or created) to address the issues, it must be implemented and then evaluated for impact (Table 3). Continuing medical education and continued professional development are important aspects of EBP, but they are primarily teacher- and learner-driven and don’t readily allow for integrated or multi-disciplinary solutions to contemporary issues in the health disciplines [180]. The focus on action and the implementation of formal knowledge in practice combined with the social communication and subjective experiential evaluation of innovation in Diffusion of Innovation Theory begins to resemble a theoretical base for the contemporary construct of KT.
Table 3 – Commonalities in evidence based practice and the CIHR knowledge translation model

<table>
<thead>
<tr>
<th>Element in evidence based practice</th>
<th>Element in knowledge translation</th>
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<tbody>
<tr>
<td>1) convert information needs into answerable questions</td>
<td>KT1: Defining research questions and methodologies</td>
</tr>
<tr>
<td>2) gather the most reliable evidence available to answer questions</td>
<td>KT2: Conducting research (as in the case of participatory research)</td>
</tr>
<tr>
<td>3) critically appraise the evidence for validity and utility</td>
<td>KT3: Publishing research findings in plain language and accessible formats</td>
</tr>
<tr>
<td></td>
<td>KT4: Placing research findings in the context of other knowledge and sociocultural norms</td>
</tr>
<tr>
<td>4) apply evidence in clinical practice (or public health programming)</td>
<td>KT5: Making decisions and taking action informed by research findings</td>
</tr>
<tr>
<td>5) evaluate the performance of the decisions made or interventions undertaken</td>
<td>KT6: Influencing subsequent rounds of research</td>
</tr>
</tbody>
</table>

There is, however, an emerging body of work (particularly in the nursing literature) that calls for a redefinition of “evidence” to one that includes more diverse body of knowledge upon which to base decisions in the health disciplines [181]. It is widely accepted in the literature of both EBP and KT that evidence is not the only basis upon which decisions are made; that personal experience, context, lay knowledge, clinical expertise, intuition and the “apprentice” factor (i.e. taking on decision-making characteristics of a mentor without the formal adoption of a decision-making rubric) all influence decision-making processes [36, 155, 173, 179-182]. These informal sources of knowledge and practice, however, continue to be undervalued which may be contributing to an power imbalance in decision-making at all stages of the knowledge translation and/or evidence based practice cycle. In this knowledge valuation dynamic, power is often concentrated with the groups who produce the “valuable” knowledge (i.e. scientific evidence) to the exclusion of those who do not have access to formalized knowledge creation pathways.

In this sense, knowledge valuation is inextricably linked to the political, social and cultural context within which it is produced, used and evaluated. Although KT strives toward equitable participatory approaches, it is effectively limited by the qualities and structures of the systems, institutions and individuals that
endeavour to undertake it. In the case of public health and dengue, these systems and institutions tend to be hierarchical organizations that rely on expert, technical and quantitative evidence that is produced, valuated and used in ways that perpetuates existing institutional knowledge monopolies [173]. At the heart of its theory and practice, KT makes an assumption that the involvement of a research-centric knowledge mediation process is both validating and democratic. The notion that health and university-based research systems are divorced from these knowledge monopolies is short sighted. Although the research-centric power structures may be more moderate or inclusive to various ways of knowing, they still represent a concentration of power in the decision-making and knowledge management process that serves to exclude agendas, issues, questions and results that do not coincide with institutionally established priorities.

At the macro-level, institutional priorities are often set by funding agencies, governments and industry partners, all of whom are embedded in the conventional, hierarchical economic, political and social structures. The innovation of KT continues to be important for policy change and public health programming improvement; much of the literature in participatory research using KT implies that the process is geared toward knowledge users, the group of people targeted with specific knowledge and who are expected to exhibit a measurable impact. The concept of knowledge users may be misleading, in that often the largest impact with the most sustainable outcome would be deep political shifts in ideology and structure, policies that would address the upstream determinants of health, and inclusive agenda-setting on the macro-level. Within existing knowledge valuation systems and power structures, policy-makers and funders should be considered as driving-force knowledge users that determine research, KT and participatory processes themselves.

2.4.3 Implications for KT in the scaling up process
The term “scaling-up” is often used to describe the process that seeks to bring the successful results of research projects (small or local-scale) to influence the
experience (i.e. improving quality of life, changing service delivery protocols, 
public health education campaigns) of a larger population (provincial, national, 
regional, global levels). Scaling-up of interventions requires the use of research-
based knowledge by institutions and organizations (governmental and non-
governmental) to change practices, perceptions and behaviours both within their 
own entities and to promote the same in others (institutions, organizations, 
government, general public).

The notion of evidence based policy gained in popularity in the 1990s during the 
promulgation of evidence based practice in the clinical setting [169]. Arguments 
for evidence based policy assume that scientific evidence or research-based 
knowledge is taken up by policy-making bodies and used by decision-makers to 
create a framework responsive to that evidence that will govern programming 
and practice in day-to-day operations [181, 183-185]. Evidence based policy 
models often assume that research-based knowledge is “taken up” from the local 
level by policy-making bodies and that it trickles back down to the local level in 
multiple different locations and contexts with positive impacts in tow. Defined 
loosely, the local level can be taken to mean a single small town or community or 
can be expanded to a regional level such as WHO multi-country regions. The 
scaled-up level may be then defined as anything from a small cluster of towns or 
communities to areas including more than one WHO multi-country region or the 
global level. Policy-making entities also exist at multiple levels; from non-
governmental community associations to Federal Governments to the United 
Nations and the like.

The relationship between evidence and policy, however, is not linear nor can it 
be assumed that evidence created in one local context will be effective in other 
local contexts without adaptation, tailoring or further investigation [33, 155, 180, 
184, 186, 187]. Evidence based clinical practice centers around using research-
based knowledge to make care decisions in the context of a particular patient’s 
experience and health. Expanding the context to include the experience, health,
goals and culture of communities and populations dictates that the decision-making and policy-making processes should also be expanded to capture contextual nuances in the complex network of actors involved [33, 180, 184, 187-189].

KT processes may provide opportunities for producers (or holders as the case may be with traditional, cultural or lay knowledge that is held within a body of people rather than produced by it) and users of knowledge and evidence can communicate effectively to achieve positive impact through a participatory decision-making process. Rather than relying on knowledge producers to impose their knowledge on users in a “push” strategy, or on knowledge users to reach out to existing forms of knowledge and evidence to answer self-identified issues in a “pull” strategy, KT advocates for exchange or cooperation between knowledge producers and users[188]. Ideally, this “exchange” becomes integrated management and policy-making at the expanded population and policy levels and requires intersectoral cooperation and action to improve quality of life [189-191]. KT platforms seek to streamline this process but must be supported by efforts in participating institutions, organizations and stakeholder bodies to incorporate new knowledge and learning strategies in their day-to-day operations.

Policy windows also play an important role in knowledge translation and research-to-policy processes. Policy windows depend on political will, recognition and awareness of issues and the mobilization of policy development resources and infrastructure. These three conditions allow for the finalization and institutionalization of new or changed policies that determine programs, service delivery and impact on real-world problems [192]. Kingdon’s (1995) multiple stream model of the policy-making process conceives of a policy window as the product of three main streams converging: the politics stream, the policy stream and the problem stream [190]. Political will, or the politics stream, can be seen as a product of time, place and political mood; new leaders, changes in government
structures, public pressures and catastrophic events can contribute to the willingness of a governing agency to engage in the policy-making process. Policy streams refer to the options and alternatives proposed by experts, decision-makers and knowledge producers to address identified issues. The problem stream is the set of issues recognized by the policy makers as problems that ought to be addressed [124, 193]. Policy entrepreneurs may play a significant role in moving the problem and policy streams into alignment with the politics stream through continued and repetitive communication and or relationships with policy-makers, can cultivate political will and/or a political “micro-climate” amenable to a particular issue and the knowledge associated with it [124, 181, 194].

This policy-making model highlights the importance of intersectoral collaboration and KT in the scale-up process of successful local participatory EcoHealth-style interventions. Without the involvement of decision-makers, advocates, knowledge producers and policy-makers together, the probability that the three streams would converge in a timely fashion to act on local, community-based evidence is very small. These actors, from all different stakeholder groups, bring the advantages of their social networks, social and political capital, expertise and capacity for action to the policy-making process. As these actors collaborate, networks merge and their qualities and attributes may be shared, transferred or stunted depending on the political streams that flow through the functional intersectoral spaces. Great care must be taken to acknowledge the necessity of equitable participation and knowledge valuations in these power-sensitive environments; even solid evidence generated through perfectly equitable, transformative and emancipatory collaboration could mutate to conform to existing structures particularly in high-powered and high-pressure policy windows.

2.5 Participatory indicator development
Knowledge translation as part of the scaling-up and research-to-policy process depends on evidence, or knowledge that has been rigorously evaluated and that is believed to
hold potential for innovation and positive outcomes. Evaluation processes are the filters through which knowledge passes in order to engage the decision-making and policy processes. Indicators and evaluation strategies are selected at the “issue-framing stage” and in line with research goals and objectives [186]. Conventionally, issues are framed through expert opinion and influenced by overarching research agendas set through funding agencies, governments and institutions. These actors determine which elements of interventions are measured and how successes and shortcomings are reported. Indicators, then, bear the same biases as the research agendas and power structures that establish them [195, 196]. Evaluation can be exclusionary to non-expert knowledge and to wider conceptions of the production of health or harm.

Participatory indicator development offers an opportunity to facilitate equitable participation and power sharing in the evaluation process. Indicators must satisfy requirements of rigour, however, they also must serve the wide requirements of a variety of stakeholders and the demands of understanding complex issues [197, 198]. Indicators dependent upon linear, scientific and technical information may not be capable of describing qualitative nuances of lived experiences and how they are affected by interventions. Moreover, the information that these indicators relay to decision-makers is not accessible to unspecialized collaborators. In addition to rigour, validity of indicators also depends on the process through which they are selected and employed [197, 198]. Participatory research and development should employ participatory means to develop indicators and evaluation strategies that reflect the richness of experience and ways of knowing of the broadest and most inclusive body of collaborators. Equitable participation in the development of indicators and evaluation strategies will require the renegotiation of cultural and social dynamics deeply connected to the production of health and harm. Specifically, the social determinants of dengue in Machala include political structures, agendas, decision-making routines and policies that must be challenged directly in order to meaningfully engage in participatory indicator development.
2.5.1 Social multi-criteria evaluation as a participatory process

Health is deeply connected to place [121, 198]. Social, cultural and political forces are highly variable from place to place, thus, the interface between local and global processes takes on unique dimensions in time, space and place. Relying on evaluation strategies that have been transplanted without consideration for the unique local context limits the potential for local relevance of results, and may decrease sustainability of resulting programs and policy [199]. Social multi-criteria evaluation (SMCE) suggests that multi-dimensional strategies to address complex issues involving human systems must be evaluated with context-specific multi-dimensional tools. The reflexive relationship between human health and social, cultural and political systems in borne out as well in public health program evaluation and policy-making [200]. Multi-criterion decision-aids as part of an equitable, participatory and socially focused research-to-policy process provide a rigorous way to systematically include indicators representing conventionally marginalized voices alongside specialized, technical indicators. Importantly, SMCE requires that decision-makers engage in a process of contextualizing selected indicators. The nomenclature of “decision-aids” implies that decisions must be considered products of a longer, more meaningful process of engagement with involved stakeholders, rather than as events dictated by arms-length measurements and esoteric mathematical models. As well, care should be taken that the legitimizing of decisions made through equitable participation must not be construed as an opportunity to shirk political responsibility for resulting programs [59]. Victim blaming may be reinforced through political manipulation of the results of “failed” or “unsuccessful” participatory programs; this unfortunate dynamic may be exacerbated if participatory indicator development or SMCE is used as scapegoat.

Social multi-criteria evaluation frameworks seek to make evidence of participatory research accessible to a wider variety of stakeholders, essentially opening the equity bottleneck. Designing SMCE decision-aids for local relevance and validity should consider:

i) ease of use and inclusivity

ii) process and end-point evaluation
iii) appropriateness and utility of results
iv) potential influence on determinants

Specific to the case of scaling-up participatory dengue prevention and control in Machala, the development and use of an SMCE decision-aid should consider:

i) use of tool in intersectoral spaces to promote knowledge sharing
ii) process evaluation reflecting on collaboration, perceptions and communication between diverse stakeholder groups
iii) end-point evaluation reflecting re-defined measures of short, medium and long-term success
iv) innovation in knowledge valuation schemes and active engagement with social, cultural and political dynamics

Ultimately, the participatory process of developing an SMCE decision-aid should be additive or multiplicative rather than antagonistic. Trusted indicators that rely on expert knowledge and priorities should not be discarded simply because they are unable to capture an adequately complete picture of the social production of dengue risk in Machala. Instead they should be seen as vital elements in a holistic description that demands the complement of qualitative, experiential and tacit knowledge in order to better convey the true and complex nature of dengue fever as a human health issue.

2.6 Theoretical foundations for methodological choices
Dengue fever as an increasingly important public health issue at the global level demands innovative thinking from those who would endeavour to address the complex challenge it presents. Interdisciplinary and intersectoral collaboration are promising approaches, but they propose complex challenges in and of themselves. Knowledge translation and participatory indicator development offer the foundations for moving innovative collaboration and partnerships from theory to practice, and underscores the need to begin with a strong emphasis on understanding local contexts, equity and transformative emancipatory framing of participatory work. Thus, methodologies should be chosen in alignment with these theories and that seek to establish new and creative spaces to challenge outmodes strategies, oppressive power structures and unjust social dynamics.
The methodological choices I have made to these ends and their specific theoretical underpinnings are explored further in Chapter 3.
Chapter 3 – Methods

The methodological choices I have made in this study build directly on the historical and theoretical foundations established in Chapter 2, situating dengue as a multi-faceted issue, with a wide range of determining forces and factors. The first sections of this chapter (3.1 and 3.2) discuss the logic and merit in employing participatory and mixed methods to meet the challenges of addressing the overarching research question investigating knowledge management strategies and their impact on equity in participatory dengue prevention and control. As discussed in the previous chapter, these guiding methodologies provide a robust practical response to the identified weaknesses of the KT mechanism. Section 3.3 describes the physical setting of the study and the communities involved in this work. The latter sections of this chapter (3.4 – 3.7) discuss the specific techniques used to address the specific research questions outlined in Chapter 1. An overview of methods used is provided in Table 4.
### Table 4 – Overview of methodologies and timeline

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<td>document analysis</td>
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<td>event notes</td>
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<td>Community meetings</td>
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<td>field notes</td>
<td>January 2011 - May 2013</td>
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<tr>
<td>Intersectoral stakeholder meeting</td>
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<td>field notes</td>
<td>February 27, 2012</td>
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<td>Focus Groups</td>
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<td>audio</td>
<td>July - August 2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>transcription</td>
<td>February - March 2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>September 2011 - January 2012</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>April 2012 - June 2012</td>
<td></td>
</tr>
<tr>
<td>Interviews</td>
<td>27</td>
<td>audio</td>
<td>July - August 2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>transcription</td>
<td>February - March 2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>September 2011 - January 2012</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>April 2012 - June 2012</td>
<td></td>
</tr>
<tr>
<td>Coding</td>
<td>-</td>
<td>-</td>
<td>September 2011 - September 2012</td>
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<td>Survey</td>
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<td>likert data</td>
<td>March 18 - April 6, 2012</td>
</tr>
<tr>
<td>Meetings</td>
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<td>notes</td>
<td>March 25 - 31, 2012</td>
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<tr>
<td>Follow-up</td>
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<td>phone survey</td>
<td>April 2 - 6, 2012</td>
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<td></td>
<td></td>
<td>comments</td>
<td></td>
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<tr>
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<td>January 2013</td>
</tr>
<tr>
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<td>survey data</td>
<td>January 2013</td>
</tr>
<tr>
<td>Community participation, empowerment &amp; wel-being survey</td>
<td>1888</td>
<td>likert data</td>
<td>March 2012</td>
</tr>
</tbody>
</table>

‡ 14 focus groups with 61 total participants; § Meetings were primarily held for the 60 community participants

### 3.1 Mixed methods for applied health research

Participatory EcoHealth or Eco-Bio-Social style dengue control presents a challenge to researchers, communities, public health officials and practitioners in that they require both qualitative and quantitative methods. Dengue transmission, and therefore dengue prevention and control, lies at the interface between human and mosquito populations; different techniques, metrics and analyses are required to monitor and understand the effects of dengue and dengue control on each of these populations. Interactions of humans with their environment are complex and understanding nuances may be key in developing effective and sustainable control strategies within specific communities and environmental contexts.
The human experience is difficult to quantify; emotions, attitudes, motivations, culture and relationships all have qualities that cannot be measured or conveyed with quantitative data in the traditional positivist paradigm. Qualitative methods allow research to access the heart of human experience; perceptions, opinions, feelings, attitudes, interpretation of events (hermeneutics) and the nature, function and value of knowledge (epistemology) in everyday life [200-204]. When working with a community on behavioural or social change (i.e. managing environmental risks to human health through dengue control), it is important to know the meaning that community attaches to the issue at hand (dengue) and the social change required to address it (community-based dengue control). Qualitative methods provide access to personal and social meanings, individual and cultural practices and how these exist within the physical environment and social context of a community [205, 206]. With respect to community-based dengue control (which focuses on community participation in the reduction of mosquito breeding sites, education campaigns and cooperation between individuals and groups of individuals), the complex relationships between social norms, culture, perception of risk, perceptions of other people or groups of people, and the importance of dengue as an issue within an individual’s and the collective consciousness of the community can all affect a program’s success. Qualitative methods are required to understand the human side of the human-mosquito interface of community-based dengue control.

The other side of this interface is the ambient mosquito population. This can be seen as solely what kinds of mosquitoes are in the physical environment, how many there are and how many are carrying dengue virus. To be useful to control efforts of any kind, this view should be expanded to include the conditions of the natural environment that affect mosquito populations; temperature, rainfall, humidity, mosquito population density, human population density, density and quality of breeding sites/habitats, larval and pupal densities within these sites/habitats, presence and density of predators in these sites/habitats, distance between individual or clusters of breeding sites/habitats, tree or brush cover in
the environment, wind direction, wind speed and day length [204, 206]. Quantitative data describing these characteristics of the vector (mosquito) population, host (human) population and the physical environment are instrumental to understanding dengue transmission dynamics, evaluating disease risk, predicting outbreaks and evaluating dengue prevention and control programs [27, 207].

The nexus of environment, humans and mosquitoes in dengue transmission requires researchers to expand methodologies to gather data descriptive of the complex nature of this interaction; both qualitative and quantitative methods are required to achieve this. The positivist paradigm of quantitative methods reliant on empirical evidence complements the interpretive or subjective nature of qualitative methods to achieve a holistic description of dengue transmission and community-based strategies for its prevention and control.

Mixed method and multiple method research use a set of complementary methodologies from both the qualitative and quantitative schools, and blend philosophical assumptions and methods of inquiry to investigate complex research questions that single approach designs cannot answer [208-211]. A mixed method design specifically calls for the use of qualitative and quantitative strategies of inquiry and investigative methods, while a multiple method design implies the use of more than one method within a single (either qualitative or quantitative) strategy of inquiry [204, 206]. When researching as complex an issue as community-based dengue prevention and control, it can be expected that multiple methods will be used on both the qualitative and quantitative sides of a mixed method design; accurately capturing a complicated picture requires different lenses positioned at different angles.

Mixed method design has gained recognition as a third, emerging research paradigm, but not without controversy or contention. Although the mixed method design combines the strengths of two different paradigms to answer “otherwise
unanswerable” questions, there is debate in the literature as to whether the data or knowledge from these disparate paradigms (i.e. positivist/empiricist vs. interpretivist/constructivist) can be combined without compromising its integrity or validity [206, 211-214]. Following the logic that different methods and paradigms can answer different types of questions, it also may follow that the data may be discordant and will not produce a final “holistic” picture but a chaotic body of incoherent or contradictory knowledge. Just above this incompatibility argument, there is a belief that mixed methods can work if paradigms and their respective results are kept separate so that their will complement one another; methods either executed in tandem or sequentially [204, 206, 211]. Conversely, there is support for the blending of paradigms to form a dynamic single paradigmatic platform, thus avoiding the issue of discordant worldviews and complete abandonment of paradigm itself.

The transformative-emancipatory paradigm (TEP) is a blending of the positivist (quantitative) and interpretive-constructivist (qualitative) paradigms [206, 210, 211]. It considers knowledge as essentially linked to the values, interests and status of the people who generate, use and interpret it; bringing together qualitative aspects of the human experience (values, opinions, culture) and empirical knowledge (mosquito density, disease risk metrics). Social Justice forms the foundation of TEP; it links knowledge and research to action in a way that seeks to change asymmetric power dynamics, social inequity and the marginalization of people or groups of people [215]. A central methodological assumption of TEP is that all communities affected by the research will be involved in the research and will have influence in methodological and programmatic decisions, with special consideration given to populations that are traditionally underrepresented [211]. EcoHealth and CBAR echo the assumptions and theoretical foundations of TEP (Table 5), naturally fitting into a cohesive approach to community-based dengue prevention and control action research: CBAR using mixed methods informed by EcoHealth and governed by TEP.
Table 5 – Principles of the Transformative-Emancipatory Perspective (TEP), the ecosystems approach to human health (EcoHealth) and community-based action research (CBAR) form consensus on guiding research methods

<table>
<thead>
<tr>
<th>Methodological approach</th>
<th>TEP</th>
<th>EcoHealth</th>
<th>CBAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformative</td>
<td>Participatory</td>
<td>Democratic/Inclusive</td>
<td></td>
</tr>
<tr>
<td>Emancipatory</td>
<td>Gender Equity</td>
<td>Equitable</td>
<td></td>
</tr>
<tr>
<td>Equitable</td>
<td>Transdisciplinary</td>
<td>Enhancing</td>
<td></td>
</tr>
<tr>
<td>Social Justice</td>
<td>Ecosystem-based</td>
<td>Liberating</td>
<td></td>
</tr>
</tbody>
</table>

The terms “community-based” and “participatory” are often used interchangeably; however, there is an important distinction to be made. The popularization of participatory approaches in recent decades has led to the appropriation of this language and rhetoric by the power structures that they once struggled against. Originating with an emancipatory practice of oppressed peoples, these terms, techniques and ideals have been changed to accommodate the institutional and political agendas of funding agencies, governments, universities and researchers to achieve measurable impact [66, 215]. This appropriation has led to a muddying of the definitions and implications of community-based research. At its inception, community-based research involved the community at every step of the research and development process, including determination and definition of research issues, questions objectives, methodologies and deliverables.

Research agendas were deeply seated within the community experience and the purpose of the research was to improve day-to-day quality of life by addressing issues in a manner consistent with the needs and context of community life. More recently, the terms “community-based” and “participatory” may describe research that includes a population-based intervention, community consultation, interactive messaging or a strategy that requires volunteer participation to carry out project objectives; none of which imply or depend upon equitable community participation or emancipatory praxis. The newer terms “community-placed” and “community-driven” have emerged in the discourse to distinguish the varying shades of participatory research. Community-placed research implies that the community is not no meaningfully involved in the determination of the research
agenda, issues, questions, methodology or evaluation, but may be involved in the execution of the work. Community-driven research implies the original intent behind CBAR, to work in equitable partnership with communities in addressing self-identified issues in culturally and socially appropriate ways.

3.2 Importance of participatory methodology

Participatory methodology in public health and global health research has experienced a resurgence in popularity, particularly with smaller-scale projects addressing complex health issues like dengue fever [183, 216]. Participatory research methodology aimed at non-medical determinants of disease transmission is a strong theoretical axis for dengue prevention and control research in Latin America and the Caribbean, as well as other regions around the world [58, 142, 217]. The majority of the literature features local successful prevention and control efforts that either lack the funding and/or time allowance for scale-up, or that lose effect upon extension to larger geopolitical scales [77, 109, 111, 139, 144, 150, 151, 218].

The Eco-Bio-Social paradigm (EBS) employed by the World Health Organization (WHO) through their Special Programme for Research and Training in Tropical Disease (TDR) and the EcoHealth paradigm conceived of and popularized by Canadian researchers both emphasize the importance of equitable community participation in the identification of health issues, conception of research questions and projects, evaluation of the projects and implementation of recommended strategies in order to achieve a sustainable, effective and acceptable health intervention [102, 122, 152]. Often in the case of EBS and EcoHealth-style dengue prevention projects, sustainability is treated as an achievable objective or an output value that can be measured and maximized through the participatory process [14, 143, 148]. As well, acceptability and efficacy are tightly linked and narrowly defined in quantitative epidemiological terms; the reductions of both epidemiological and entomological indices are seen as irrevocably tied to the personal values and behaviours of program participants. Participatory strategies like Communication for Behavioural Impact
(COMBI), social mobilization, EcoHealth Approaches, and EBS all firmly assert that addressing the links between environmental, social, political, cultural and biological factors and human health also require a knowledge translation (KT) process that facilitates behaviour change and changes in policy, programming and practice to improve human health [30, 56, 102, 119, 149]. This KT strategy ought to include a participatory evaluation process that leads to policy recommendations and that serves to i) launch a new iterative participatory action research cycle and ii) strengthen intersectoral collaboration and forge new intersectoral spaces.

The methodological choices made in this body of work were deliberately done to, insofar as possible, elevate equitable participation to an objective in and of itself, rather than a means to achieving a higher objective. The gross evaluation framework of the EBS parent project (EBS-Ecuador project), “Meeting capacity-building and scaling up challenges to sustainably prevent and control dengue in Machala, Ecuador”, that provides the foundation for this work was determined by expert opinion and based on the results of pilot studies without the participation of the multi-stakeholder group. Nevertheless, a concerted effort to open the research and evaluation process to as many stakeholders as possible, in the most transparent way possible has been made in the design of overall methodology, instruments, communication tools, analyses and knowledge sharing strategies.

Importantly, this research follows an iterative action research model that holds as its primary purpose the applicability and utility of results in addressing issues in the context specific to the multi-stakeholder group involved [219]. The basic methodological unit of this action research spiral is a Look-Think-Act cycle, a praxis based on sequential rounds of collaborative observation, planning, data collection and analysis. This research spiral is heavily informed by ethnographic principles that state
i) human behaviour and the organization of people, groups, communities and institutions are variable and are specific to local contexts,

ii) understanding social, cultural and organizational dynamic is an inductive and creative process driven by local experience and perspectives

iii) the researcher is the primary instrument of data collection [203, 220].

The methodological nexus between ethnography and action research is the application of the research to the local context in order to first increase understanding of sociocultural dynamics in communities and institutions, and then to affect positive change in the same communities and institutions [221, 222]. This ethnographic action research is an iterative-inductive process borne on the theoretical foundations of interpretivist and constructivist theory. Interpretivism guides the researcher toward establishing theory through the process of data collection, reflection and analysis [221]. Constructivism posits that the researcher inextricably co-contributes to the dialectic-hermeneutic dynamic that is specific to the local context through experiences and interactions among and between research collaborators and participants; that these theories and findings are constructed through relationships, perceptions, culture and social connections [203, 223-225].

In order to clearly understand social and programmatic links, perceptions and human experiences within the dynamic of participatory dengue prevention and control, there must be a bridging of the disciplinary divide to include the positivist convention within which the EBS-Ecuador is situated. Positivist theory is deductive in nature, often relying on quantitative data to test an already established theory [223]. Methodological pluralism and pragmatism provide this bridge in mixed methodology which encourages eclecticism and posits that methodology ought to be chosen to best answer research questions arrived at through an organic and iterative process of observation and inquiry [226]. Participatory action research and KT targeting a complex issue with ecological,
biological and social factors within a large multi-disciplinary, multi-sector stakeholder universe requires an inclusive approach that values many ways of knowing, being and understanding.

3.3 Eco-Bio-Social project design
The TDR-IDRC funded parent project “Meeting capacity-building and scaling-up challenges to sustainably prevent and control dengue in Machala, Ecuador” is part of a multi-country three-year project to investigate the ecological, biological and social factors that contribute to and determine the presence of the mosquito vector *Aedes aegypti* and dengue virus transmission [227]. The overall project design is two-phase: 1) a situational analysis must be undertaken to understand these ecological, biological and social dynamics in order to 2) design and implement a participatory intervention targeted principally to address these explored dynamics. Specifically, the intervention phase of the EBS-Ecuador will comparatively evaluate two dengue prevention and control programs; i) a conventional, responsive, vertical program and ii) a newer integrated participatory approach relying on community-based action, practical child education, mosquito larval habitat reduction and larvicide [222]. The methodology of this thesis is nested within the social arm of the overall EBS-Ecuador project design contributing to both the situational analysis and implementation/evaluation phases (see Appendix 1 for a more in-depth description of EBS-Ecuador project methodology).

The situational analysis phase of the EBS-Ecuador project included a household survey in each of the 2000 participant homes administered in person to a member of the household over the age of majority by a trained vector control worker to collect basic demographic data as well as information on dengue infection history, socioeconomic status, housing conditions, access to public works (sanitary) infrastructure, water use and storage behaviours, knowledge levels regarding dengue fever and dengue virus transmission, dengue prevention behaviours in the home and access to health and vector control services. An addendum to this survey was used to collect more in-depth information regarding
financial autonomy of the household, migration history and ethno-cultural heritage. Entomological surveys were also carried out within each household and in public spaces; the surveys counted containers, identified container types, presence of water and presence of larval and pupal stages of the vector Ae. aegypti in those containers. Community meetings, informed consent and the first surveys were carried out from 7 Feb – 14 April 2011. The survey instruments were developed based on instruments developed by the TDR team in a previous multi-country EBS dengue prevention and control study in Asia [119, 228], that were adapted to the context of the Latin America and the Caribbean WHO region (LAC) through two participatory workshops of the TDR EBS-LAC Community of Practice in Antigua, Guatemala (July 2009) and Guadalajara, Mexico (October 2010). The EBS-Ecuador project design provides a gross evaluation framework for the intervention-control comparison of four basic categories, Cost, Efficacy, Acceptability and Sustainability, and three basic stakeholder groups, Community, Government and Researchers.

3.3.1 Study area and participant groups
Machala is a city of 245,972 people situated at 3.2667°S, 79.9667°W and 4 m above sea level on the Southwestern Pacific coast of Ecuador [119]. The climate is tropical with an average temperature of 25°C, average humidity of 90%, and average annual rainfall of 713.28 mm. The rainy season is normally from November to April and the dry season from May to October, however, local climate trends have become increasingly variable and in recent years rainy periods have become more common during dry seasons [219].

Twenty clusters consisting of approximately 250 houses each were selected from a geographic map of Machala using a random number generator to participate in the randomized controlled cluster trial of the EBS-Ecuador project. The household is considered the basic unit of data collection and analysis; 100 of the 250 homes in each cluster were enrolled in the study with informed consent resulting in a total of 2000 participant households. These 20 clusters correspond
closely to 20 neighbourhoods in Machala and were randomized to intervention and control treatments (Table 6).

<table>
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<tr>
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<th>Treatment</th>
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<td>Control</td>
</tr>
<tr>
<td>9</td>
<td>Venezuela</td>
<td>Intervention</td>
<td>19</td>
<td>Mario Minuche</td>
<td>Intervention</td>
</tr>
<tr>
<td>10</td>
<td>Luz de América</td>
<td>Intervention</td>
<td>20</td>
<td>El Retiro</td>
<td>Control</td>
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### 3.4 Ethnography: A window on social determinants of health

Ethnography is a qualitative scientific method for gathering information about and describing human experiences, relationships and. The core concept of ethnographic research holds that ways of being, living, learning, working and making meaning are specific to place, space and context, and vary from person to person [229]. Following this foundational assumption of complexity and depth of experience, ethnographic observation and description are methodological tools engineered for open discovery. Ethnographic interpretation of actions, social structures, behaviours and issues must primarily be based on a deeper understanding the lived experiences of those who are most involved or affected, and secondarily upon the experience, training and preparation of the ethnographer [221, 228, 230]. These two elements are intimately linked because the ethnographer is the primary instrument for the collection, description, documentation and analysis of experiences to construct and interpret a representation of observable phenomena. Ethnographers bring their own voice and narrative to their practice, they shape and in turn are shaped by their
ethnographic work creating an iterative, reflexive process seeded through participation (close or distant) in the phenomena that drive the research [221, 230, 231].

Advocacy ethnography, a relatively new term and orientation within the field, invokes the practices of critical ethnography, research reciprocity and activism research; all of which come together to facilitate a focused ethnographic contribution to critical praxis in the transformative emancipatory paradigm [232]. Research addressing the social determinants and social determination of health must be anchored in the daily experiences and realities of those who are affected by the systematic denial of their right to human security, political agency, self-determination, resources, services, and dignity [231]. Ethnography provides a context within which to systematically explore the difficult to measure effects of structures, policies, programs and practices that perpetuate health inequities and create harm.

3.4.1 Ethnographic field methods
Exploratory participant observation was undertaken in a series of field visits to Ecuador, spending time in both Quito and Machala, totaling 50 weeks: 7 June – 28 July 2010 (7 weeks), 16 January – 23 March 2011 (9 weeks), 31 May – 2 Sept 2011 (14 weeks), 7 January – 13 April 2012 (14 weeks), 30 September – 18 October 2012 (3 weeks), and 10 April – 1 May 2013 (3 weeks). Daily observation, field notes recording, document collection, learning local dialect and forming relationships with members of all stakeholder groups began as part of the initial orientation visit (7 June – 28 July 2010) and continued throughout the timeframe of the project. Regular cycles of community meetings in each of the 20 EBS-Ecuador project participant neighbourhoods also contributed to longitudinal relationship building and ethnographic observation over the life of the project, as well as a large EBS-Ecuador project meeting event was held 27 February 2012 in Machala that brought 170 stakeholders together from all stakeholder groups. Field notes and collected documents were organized and refined during the data cleaning and analysis stages of this study and were used in conjunction with
interview and focus group transcripts for the social analysis and writing of vignettes explored in Chapter 4 of this thesis. The vast majority of project activities and community interactions were done in Spanish, as it is the dominant spoken and written language in Machala. As such, field notes, collected documents, conversations, interviews, focus groups and transcripts were Spanish-language, dictating that the working language for the analyses of this study was also Spanish. I only translated the excerpts and quotes used in this thesis to English for the purposes of reporting to a primarily English-language academic audience.

3.4.2 Self-ethnographic reflections

The nature of this study, as well as the nature of my involvement in the EBS-Ecuador project, dictated that its undertaking and that of the overall project were done in conjunction; the value of this work is that it is embedded in the processes of participatory global health research, program design and development, evaluation, knowledge translation and policy-making. As such, the research described in this thesis is a product of my involvement both as a PhD student tackling a specific aspect of, and as an international research coordinator for the EBS-Ecuador project. Over the life of the EBS-Ecuador project I have represented “our country” at all of the workshops for Principal Investigators of the TDR-IDRC Latin America and Caribbean Community of Practice for Innovative Ecosystem Management of Dengue and Chagas Prevention (EBS-LAC CoP) meetings to report on and evaluate completed or in-progress work, and to design and develop next steps and subsequent research cycles (Guadalajara MX 2010, Mérida MX 2011, Fortaleza BR 2012). Through these workshops, the EBS-Ecuador project was developed with the influence of a multi-country community of practice (Brasíl, Colombia, Cuba, Ecuador, México, Uruguay) within which our own bi-national collaboration (Ecuador, Canada) formed working partnerships that shaped the various processes involved in conceptualization, design, development, operationalization, evaluation, and reporting.
My time in Machala, 2 ¼ of the last four years spread over several lengthy field visits, was dedicated to the undertaking of the overall EBS-Ecuador project and to the research presented in this thesis. Both my Bachelor of Science (Hon.) and Master of Science degrees addressed the public health issue of mosquito borne disease through the lens of entomology, vector ecology and mosquito control. West Nile virus research in Manitoba from 2000 to 2004, and then Aedes aegypti and Dengue virus research in Vancouver and Tapachula, MX from 2005 - 2008, situated my expertise firmly in the technical realm of entomological and related environmental dengue risk reduction for the purposes of dengue prevention at the community level. Fortunately, this meager preparation was useful and accommodated within the infinitely larger and deeper expertise of the teams at the Machala Office for the National Service for the Control of Arthropod-borne Diseases (SNEM), the provincial (El Oro) and regional (Machala) Ministry of Health (MoH) Areas, and the participating communities of Machala. The embedded nature of my thesis research required ethnographic observation and the passive and active gathering of opinions, experiences and impressions from a wide and diverse stakeholder universe. To this end, many of my field notes and observations, as well as realms of understanding and theories arising from them, were born of my involvement in activities dedicated to the EBS-Ecuador project; they were not the result of orchestrated interactions specifically for “ethnography” that would have defeated the purpose of the methodology. Passive data collection, then, was dependent on the activities and efforts of the overall project; active data collection via surveys, interviews, focus groups, meetings and questionnaires was varied.

I would be remiss if I did not critically examine, at least in part, the nature of my “embeddedness” and collaboration relationship with the EBS-Ecuador project and the effects it may have on research and engagement within the context of participatory dengue prevention and control research in Machala through global research partnerships. Firstly, the interdisciplinary nature of my PhD research is of primary importance to the way the study presented in this thesis has taken
shape. As discussed above, my formation preceding this research had been primarily based in the positivist approach of basic sciences – laboratory biology framed within the context of investigating ecological and evolutionary mechanisms that support conventional causal understandings of vector-borne disease. A growing personal dissatisfaction with what I perceived to be a well-meaning yet ultimately ineffectual approach to addressing complex the human health issues of vector-borne diseases lead to the active pursuit of strategies that had the potential to address the glaring issues of inequity that clearly contribute to the persistence of poor health (including vector-borne disease) in neighbourhoods the world over. Theory, literature, and story from Paolo Friere, Paul Farmer, Fidel Castro, Ernest Stringer, Amartya Sen, Bob Evans and the Zapatista movement compelled me toward considering non-medical determinants of health, the production of harm through macro-level neo-liberalist and extractive economic policy, and the importance of addressing inequitable power-sharing (or not sharing) as the places from where promising strategies may be developed. This deliberate paradigmatic and disciplinary shift was, in a very real sense, driven by a palpable sense that I had been participating in a disempowering dynamic that mainly served the people involved who were not actually affected by disease transmission risk (including myself).

This thesis represents my first foray into formal qualitative research and, in particular, to engaging with social, cultural and political dynamics in Latin America, Ecuador, El Oro and Machala in order to challenge the systems of influence that determine the presence of dengue vectors, dengue fever transmission risk and the persistence of dengue fever and severe dengue in Machalan neighbourhoods. Therefore, I have chosen to engage with this complex and interconnected web of people, environment, interactions and governance through the lens of what I see as the intersection of constructivism/interpretivism, critical pedagogy, participatory action research and social determinants of health. The questions that I had when beginning this work were: Who are the people that are involved in and affected by dengue in
Machala? How do their human experiences differ and how might that shape the way they interface with dengue and dengue-related harms? Are they hopeful that the harm they experience in their daily lives caused by systems of influence can be healed/stopped/reduced? How do they feel/what do they think about global health research as a mechanism for positive change? What is their history and imagined future as it pertains to participatory, community-based and community-driven work to address inequities and to improve health and well-being in their own lives, homes, neighbourhoods and larger communities? How can global health research contribute to transformative emancipatory work with communities to address dengue and dengue-related harms, while simultaneously critically examining its own contribution to those harms? And finally, should I as a white Canadian graduate student (with all of the particularities of my own culture, history and orientations and their implications within global systems of influence and harm) seek to undertake this work; and if I do, what will that look like?

Essentially, my approach to the research described in this thesis was heavily influenced by the goal of meaningfully participating within a learning organization; one that addresses challenges through building on locally generated experience and knowledge to work toward addressing an identified issue (bottom-up and iterative, equitable approaches geared toward inclusion and appreciating richness in diverse knowledge) rather than transmitting pre-defined problems and their solutions for implementation in a chosen geopolitical coverage area. The theoretical and methodological choices of the constructivist/interpretivist approach with an emphasis on social justice, equitable participation and community-based approaches supported this general approach and allowed the research to organically evolve from shared experience with subsequent stages building on the ideas, knowledge and energy of previous activities and efforts. I hope that I have managed to achieve a semblance of this ideal through this work.

My “embeddedness” in the overall EBS-Ecuador project and engagement with global health research is not without harm. Although humility and critical self-
reflection in engagement, learning and service were guiding principles for this work, it remains that the dynamics of underqualified expertise (globally Northern underqualified experts are often empowered over globally Southern well-qualified experts to undertake global health research through asymmetric power dynamics in funding and research design), globally Northern dominance in decision-making processes at the international level (my participation as a PhD student in the EBS-LAC CoP workshops while Machalan partner participation has been minimal at that level), and the English-language appropriation of local Spanish-language knowledge, evidence and research products (my orientation as an academic requires that I seek out higher impact factor journals, the majority of which are English-language, for at least some of the publications arising from this thesis; rendering those particular publications as inaccessible to non-English speaking researchers and communities in Machala). Moreover, this thesis is the original and most in-depth research product to come from the participatory processes I was engaged in with the diverse body of stakeholders in Machala; it is written and will be evaluated in the context of an English-speaking Canadian Institution. In the least, this limits the audience with whom it can be meaningfully shared; at most this renders it totally inaccessible to the overwhelming majority of people upon whose experience this research is built. Along with building meaningful and productive North-South partnerships to enable advances in dengue prevention and control in Machala, the systems within which this research is conceived and written facilitate the appropriation of the contributions, lived experiences and knowledge of already marginalized individuals and communities for the purposes of furthering the reach of academic knowledge on the subject. This is an acknowledged dynamic within the EBS-Ecuador team and our collaborations with community and other stakeholders; it behooves us to confront publishing agendas, conventional knowledge dissemination strategies, and perhaps even the exclusionary nature of knowledge appropriation as academic currency perpetuated by academic, governmental, non-governmental and funding institutions as integral to the success of this work.
3.5 Social network mapping and analysis

Social network mapping and analysis provide robust methodologies to investigate specific research questions one and two outlined in Chapter 1. Stakeholder identification and social network mapping identifies who is involved in and affected by participatory dengue prevention and control programs in Machala; while social network analysis provides basic information about how these actors are connected through interaction. Ethnographic methods, as prefaced in the previous section and explored further here, are needed to frame the social network mapping and analysis to fill in the important and more nuanced information about the quality, purpose and implications of these interactions in order to understand how they come to bear on evaluation, KT and research-to-policy processes.

3.5.1 Toward a socio-cultural understanding of dengue

Ethnography, as a popular methodology in the disciplines of anthropology and sociology among others, points out that human beings exist within complex social systems with known and “hidden” elements and dynamics. In particular, ethnography can provide insight into how events or processes unfold and can do so in situ, while the processes or events are unfolding [59, 231]. Community-based dengue prevention efforts are decidedly embedded in social contexts and cultural processes that are particular to time, place and space; cultivating in situ understanding of these issues and processes can then be conceived of as site-specific. In the same sense that site-specific art is a creative and purposeful undertaking designed for a particular socio-geographical space with its own cultural and political dimensions, so can we view ethnography as the creative foundation of a constructivist, interpretivist approach to plan activities, build consensus and promote the sharing of knowledge and power while holding the social and cultural contexts as centrally important to the vitality and meaningfulness of the endeavour [233, 234].

Social network mapping and analysis adds a descriptive, process-oriented dimension to the often retrospective, output-oriented goals of monitoring and
evaluation. With its theoretical roots in sociometry, social network analysis incorporates the notions of socio-geographic particularity and influence of social systems on decision-making processes [233, 235, 236]. Akin to the ecosystems concept, wherein a myriad of factors contribute to interdependent processes that affect both individual elements and the whole of the system simultaneously, social network mapping and analysis proposes that human beings seldom act or react alone when faced with decisions and events. Rather, human beings interact with each other individually, with the social fabric to which they belong, and with the historic and cultural dimensions of that social fabric in a dialectic process that creates and recreates the socio-geographic particularity to which they belong [236-238]. Scaling-up of participatory dengue prevention and control interventions, or adapting an intervention for program implementation is complex processes that carry weighty implications for all stakeholders involved. Monitoring and evaluation of the intervention itself, as well as the scale-up process are necessary to equitable power-sharing, sustaining community involvement and program institutionalization and should consider social and cultural dimensions [233, 239].

3.5.2 The importance of social mapping

Ethnographically framed social network mapping and analysis seeks to identify and describe social groups and their connections to one another through exploratory inquiry, in-depth community-level qualitative interviewing and behavioural observation [32, 112]. Social network maps are visual-spatial representations of the organization of individuals and groups as they pertain to a common event, dynamic, issue or way of living. Ethnographic observation and framing of the social network maps adds the further dimensions of influence and culture, both of which come to bear heavily on multi-stakeholder decision making processes. Qualitative and descriptive research such as this, is crucial to cultivating a clearer contextually-relevant understanding of the outcomes of the EBS-Ecuador project cluster study and to making effective policy recommendations based on those outcomes [233].
When considering health policy decision-making and program implementation as a function of a social network, there are also geopolitical considerations in addition to the socio-geographical particularity. Through the “humanness” of the social network, not only are the policy options and policy decisions held within a particular time, place and space in terms of social, cultural, historical and geographical influences, but they are also influenced and determined by political climate, political will and policy windows [240, 241]. This is not a closed triangle (socio-geographical, geopolitical, socio-political) of influence on the character of the social network, however we may consider this as a basic framing of how ethnographically-framed social network analysis establishes the foundation for understanding human systems (Figure 5). In keeping with EcoHealth and Action research principles, we can envision the social network is seen as a product of environmental, historical and cultural forces, held within the crucible of social, political and geographical influence.

![Figure 5 – Influence framework for ethnographically framed social network analysis](image)
Social networks are made up of individuals that belong to groups, communities, and other aggregations, that all interact with one another; the individual is the most basic unit of observation in ethnographic social network mapping [242, 243]. Each of these aggregates, and in turn, the individuals that belong to them, exists within a culturally sanctioned hierarchy where power is allocated according to position. Importantly, members of the same aggregate, even members of aggregates at the same level within the hierarchy may behave in the same way [233]. Considering access to information, political agency, disciplinary training and formation, decision-making processes and outcomes may be determined to a certain degree by location within a social network.

3.5.4 Social network structure and function

Visualization of complex networks and interactions between stakeholders and stakeholder groups are the particular strengths of social network mapping and analysis. In order to understand knowledge management strategies, it is necessary and prudent to form a foundational understanding of the actors that engage with knowledge at various different levels and in various different specific contexts. I chose the following methods and their underlying theory framed by ethnography, to address my first specific research question regarding who is involved with participatory dengue prevention and control in Machala and the ways that they interact. The ethnographic methods described in section 3.4 of this chapter lay the foundation (primary step) for social network mapping and analysis including stakeholder analysis (secondary step); they interact again, in an iterative way, with the social network mapping and analysis (tertiary step) to address the second specific research question regarding the effect of stakeholder interaction and perceptions on evaluation, KT and the research-to-policy process.

3.5.4.1 Social network graphs

Social network graphs are two-dimensional representations of relationships between individuals or groups of individuals in a social system. Graph theory and the visual plotting of social networks allows for a mixed approach to
understanding relational dynamics within said social system [244]. Combining quantitative and qualitative interpretations of relationships anchor observational and descriptive network data to network function [241, 245]. Social network analysis as a tool places primary importance on relationships between actors, and in turn, seeks to characterize an actor or a group of actors by the kinds, quantities and prominence of the relationships each possesses [236]. Let us consider, for example, a network that is being observed for the purposes of a change in policy: the actors and their relationships to one another form a network structure, which influences network function, which influences and is influenced by actor priorities and group agendas, which influences and/or determines the way (when, how, if) in which a policy is made [246].

3.5.4.2 Nodes, edges and degree
Social network graphs represent actors or social entities as nodes or points; the relationships between actors are represented by lines or edges. Non-directional edges are used to demonstrate the existence of a connection between two nodes without specifying functional qualities of the relationship. Directional edges are used to demonstrate the nature of a relationship between two nodes: a uni-directional edge would denote the transmission of information, power or resources from an initiator node to a recipient node, a bi-directional edge would denote a relationship with some degree of reciprocation in the flow of information, resources or power [233, 236, 245, 246]. It is important to note, however, that directional edges do not provide all of the information necessary to fully interpret the significance or function of a relationship. A bi-directional edge describing a fully reciprocal and equitable power-sharing relationship between a community group and a government decision-maker would, in terms of the social network graph, appear indistinguishable from a relationship in which complex information regarding the experience and needs of a community flow toward a decision-maker, and where disempowering messaging irrelevant to the needs of the community are transmitted back. In this sense, there is an important distinction to be made between directionality and equity, one in which ethnography plays a pivotal role.
Importantly, graphs can be viewed as a whole made up of many parts. A graph may represent the social network as it can be conceived to include the entire universe of actors as it pertains to the event, dynamic or issue in question. In this case, the universe of actors would be all stakeholders and stakeholder groups identified as part of dengue prevention and control in Machala. Sub-graphs, or graphs that include only partial representations of the entire network, can be node-generated or line-generated. For the purposes of this research, a node-generated graph will be considered as a representation of a portion of the social network between a pre-determined set of stakeholders (i.e. all stakeholders who are officially employed by the Ministry of Health and work in dengue control), and a line-generated network will be considered as a representation of a portion of the social network that is described through a particular kind of connection (i.e. all stakeholders that are included in the calculation and reporting of official epidemiological statistics for dengue in Machala). Node-generated networks are determined by specified groups of people, whereas line-generated networks are determined by specified relationships between actors [244, 246].

Recalling that the individual (node) is the basic unit of observation for social networks, and that describing the way that individuals are embedded in a complex social system involving relationships (edges) is the essence of social network analysis, the next step ought to be finding a way to describe those connections at the individual level in a way that may be aggregated to describe attributes of the network or subsets of the network. Degree is such a concept that describes the number of edges associated with each node in a way that can mathematically describe “connectedness” within networks as a function of their density [236, 245]. Degree considers the number of edges that are associated with a given node, or the number of relationships or connections an actor has with other actors in the network. Graph theory as a mathematical conceptualization of a social network states that each node in a graph has a maximum number of connections that can be made; if every node in a graph is
connected to every other node in the graph then the network density would be complete or equal to 1, if there were no connections at all between actors the network would be empty with a density equal to zero, with all other intermediate graphs having a density calculated as the proportion of all possible connections present in the graph [245, 247]. Therefore, the degree of individual actors in a network or sub-network directly contributes to the density of the same. In other words, the relationships each stakeholder has within a network, determines the overall quality of interconnectedness of the network.

Directionality of connections held by a particular actor may imply relationship choices made by said actor, which in turn may also have implications for the character of the social network or sub-network to which they belong. Actors or nodes in a directed graph, or digraph, can be classified as an i) isolate if it has no connections with the other nodes in the network, ii) a transmitter if the node possesses only outgoing arcs, iii) a receiver if the node possesses only incoming arcs and iv) ordinary if it has both incoming and outgoing arcs, where arcs are directed edges. The closer examination of the degree of a node would yield the number of out-going and in-coming arcs, that is, the number of connections initiated by an actor and the number of connections that are received by the actor. These are referred to as indegree and outdegree respectively, and they offer a further dimension to density and permit the realization of a more in-depth likeness of the true social system [245, 248].

3.5.5 Centrality: degree, closeness, betweenness

A variety of terms and concepts exist to describe the organization of people and groups of people within social systems. Whether microcosm or macrocosm, patterns and hierarchy can be found, explored, explained and, in a way, understood by an inquisitive observer. In this sense, much of the language used to describe social phenomena echoes the act of observance, both from outside and within the group, organization, society, culture or geopolitical unit. Social network mapping is concerned with understanding form as well as function, influence as well as place; this is often described as visibility or prominence
within a network. If one is connected to other actors through communication or interaction one is visible to them, as one’s visibility within a network increases one becomes more prominent [87, 245, 247]. The interconnectedness, then, of the actors in a social network can be interpreted as the degree to which one is “seen”, observed or acknowledged within a network by others who are also “seen”, observed or acknowledged in their own right. Visibility in terms of interpersonal communication, knowledge exchange or diffusion of innovation can be a direct result of their personal connections, or a result of the connections in their greater network [236, 244, 249, 250].

Centrality and prestige are both measures of prominence or importance within social networks associated with degree, incorporating the notion of directionality and non-directionality of the relationships in the network. Centrality describes connections between actors and does not take directionality into account; in this sense the importance an actor derives from the network is by number of connections with other actors [244, 248]. Characterization of relationships through which communication occurs, knowledge is exchanged, and decisions are made as non-directional may result in a loss of richness in understanding social networks. As resources, ideas and power are shared through interactions, the rhetoric of “initiator” and “recipient” carry implications for network structure, function and their interpretation. Prestige focuses on directional relationships; an actor’s prestige increases the more connections they have in which they play the role of “recipient” [236, 251]. That is, a prestigious actor would have a high in-degree, however, it is important to note that a prestigious actor should not be assumed to be popular [244]. Notoriety may be a better lay-language term in that notoriety may carry positive or negative social implications; a noted author and a notorious scoundrel may share the same degree of prestige in a network.

3.5.5.1 Degree centrality
Degree centrality is a relatively straightforward concept in that it uses the degree of a node as a centrality index. As described above, degree centrality is only concerned with direct or adjacent connections between actors and it may or may
not incorporate the concept of directional relation between actors [236, 244]. In
the interests of comparison either within or between networks, degree centrality
of actors may be expressed as the proportion of adjacent connections that are
active for each actor. Ego-density is also useful when comparing actors within a
network. The ego-density index borrows theory from the “ego-centric network” in
which a network is described as the personal connections of an individual (the
ego) to other actors (alters); qualities of the relationships between the ego and
the alters are described, as well as the ego’s impressions or descriptions of the
relationships between the alters [244]. Ego-density describes proportion of all
possible connections made within the network by a particular actor. Overall
network density describes the proportion of total possible connections made
within the network, it can be used as an indicator of ease of coordination
between actors [252].

3.5.5.2 Closeness centrality
Closeness centrality refers to the ease with which a given actor can access other
actors in a network [233, 244]. With respect to communication dynamics,
closeness centrality may also carry implications for appropriateness and
timeliness of messaging, information sharing and participation in decision-making
processes [253]. An actor is said to be “close” to other actors in a network if they
can communicate without the aid of intermediaries or the involvement of other
actors; short, direct communication paths with a large proportion of the actors in
a network would result in high closeness centrality. This is often used to describe
an actor’s location within the network as a whole. The measure of closeness can
be associated with the independence of a given actor, and may be indicative of
the multidisciplinarity of a network if multiple actors with high closeness centrality
are present [244, 252].

Closeness centrality is calculated as follows:

\[ C_c(v) = \frac{1}{\Sigma_{t} d_G(v, t)} \]
Where closeness centrality \((C_c)\) is calculated as the average distance of a given node \(\nu\) to all other nodes in the network \(\Sigma_{t \in \nu} d_G(\nu, t)\) [254]. This equation uses shortest paths within a network to calculate distance; each path consisting of nodes and their connecting edges, the length of which is the sum of the weight of each edge [255].

### 3.5.5.3 Betweenness centrality

Betweenness centrality is often used as a measure of an actor’s capacity to control or contribute to communication dynamics by way of being located on an edge or communication path between two other nodes [254, 256]. This is often used to describe an actor’s location at a “local” level within the network, invoking ideas of influence and communication for particular scenarios rather than for the network as a whole. Rather than multidisciplinarity, betweenness centrality may refer to intersectorality or bridges between distinct (disciplinary or sectoral) clusters of actors [257]. In this respect, measures of betweenness centrality may provide insight for identification of catalytic actors for intersectoral and/or participatory evaluation and decision-making processes.

Building on the same logic and descriptors for the above equation used to calculate closeness centrality, betweenness centrality describes the frequency with which a node appears on the shortest paths between other nodes in a network [254, 255]

### 3.5.7 Social network mapping methods

Stakeholder identification, rough network mapping and identification of domains of interest also began as part of initial ethnographic observation during the orientation period that allowed for the selection of key informants. This judgment sample of informants was designed to include key informants from all identified stakeholder groups and to begin the first round of a series of interviews and focus groups driven by snowball sampling [254, 258]. Semi-structured interview
and focus group guides were designed to gather information on identified domains of interest: health priorities, personal experiences, behaviours and perceptions about dengue and dengue prevention, the stakeholder universe and social network, communication patterns and culture, evaluation criteria and process, and power dynamics (Appendix 2). Interview and focus group participants all gave written informed consent prior to participating; 35 audio-recorded sessions were undertaken from 5 July – 24 August 2011. As the exploratory data-gathering phase progressed, ethnographic observations were entered into two stakeholder analysis matrices: a stakeholder relationships summary and an expected project impact summary. A third stakeholder analysis matrix regarding power and position was completed after the social network analysis was complete.

Data cleaning and organization, preliminary analysis of field notes, written interview and focus group notes and transcription of interview and focus group audio files into Microsoft Word files was done in from 3 Sept 2011 – 6 Jan 2012. During this time interviews were pre-coded to i) refine the definitions of the foundational domains of interest and factors of interest, ii) establish preliminary versions of relational social network models, iii) identify cultural and social dynamics affecting related to the EBS-Ecuador project, iv) a rough matrix of evaluation indicators, v) form the basis of a participatory indicator development survey and vi) form the basis of an empowerment and well-being survey to be administered during the subsequent field visit to Machala. Six additional audio-recorded interview and focus group sessions were done from 16 Feb – 7 March 2012 in order to fill data gaps prior to designing the final survey instruments. A total of 14 focus groups and 27 interviews were conducted over both data gathering stages of this study. The vast majority of project activities and nearly all community interactions were done in Spanish, as it is the dominant language in Machala. All recorded sessions, with the exception of one interview with an Ecuadorian-American researcher, were conducted in Spanish, meaning the transcripts used for the analyses were also Spanish-language documents. I
translated the specific quotes used in the results chapters of this thesis to English for the purposes of reporting this research to an English-language audience.

Transcribed focus group and interview Microsoft Word files were migrated to TAMS analyzer [257] and were coded in two stages: preliminary coding from 3 Sept 2011 – 6 Jan 2012, and full coding after the final data collection 7 March 2012. The coding of these data contributed to a refining of the i) preliminary stakeholder relationships summary and expected project impact summary, ii) definitions of the foundational domains of interest and factors of interest, iii) full relational social network models, iv) explorations of cultural and social dynamics affecting related to the EBS-Ecuador project, v) elaboration of case-studies to illustrate these dynamics and how they may affect the implementation, evaluation and scale-up processes of participatory dengue prevention and control programs in Machala.

3.5.8 Coding progression
Exploratory ethnographic observation yielded a basic coding framework based on the domains of interest established by the EBS-Ecuador project and the research questions of this thesis (Figure 6). The basic coding framework was constructed to facilitate data collection on the social network, social determinants, dengue prevention and control strategies in Machala and their evaluation. This basic code frame was developed in parallel with the semi-structured interview guide.

**Figure 6 – Basic coding structure based on identified domains of interest and ethnographic observation**
Sub-sets of codes for each domain of interest evolved through the data cleaning and transcription process, focusing on indicator development and attempting to describe the feelings, expressions and experiences of the participants in their socio-political context. Transcripts of the interviews and focus groups were coded using a preliminary code set that was added to and continuously developed as the coding progressed. Transcripts coded early in the process were revisited and re-coded with the complete code set (Appendix 2).

3.5.9 Social network analysis

Lists of identified stakeholders and their relationships to one another, (i.e. a node list and an edge list) were developed using the responses to questions 3, 4, 5, 6, 7 and 8 in the semi-structured key informant interview guide (Appendix 3). These questions were specifically targeted to elicit responses regarding relationships and communication patterns for identified stakeholders or actors in the social network as it pertains to dengue prevention and control in Machala. The semi-structured nature of the interviews and the open-ended question 14 allowed for further consideration of these relationships through non-targeted or respondent-driven exploration.

A social network graphs were constructed from these node and edge lists using the software Gephi, version 0.8.2 [259]. Degree, closeness and betweenness centrality were calculated also using Gephi, version 0.8.2, the algorithms for which are found in Brandes (2001) [260, 261].

3.6 Evaluation tool development

Building on the ethnographic, social mapping and analysis methods outlined in previous sections, I chose a participatory indicator development methodology to interrogate the assumptions built-in to conventional expert-driven evaluation strategies. Again, these methods and the specific choices made during the unfolding of the evaluation tool development process were heavily informed by the accompanying ethnography. In this way, I endeavoured to address the third
specific research question regarding the possible need for new tools to support more equitable evaluation and KT processes with a strong emphasis on equitable participation and a vision for improved health equity. As with other tools, surveys and interactions, Spanish was the working language for all interactions and work done in Machala; I translated the tools, quotes and other materials into English for the purposes of this thesis and reporting to a primarily English-language academic audience.

3.6.1 Participatory indicators and knowledge valuation

As discussed in Chapter 2, current dengue prevention and control programs, regardless of participatory or community-based design or elements, are evaluated based on quantitative data. Conventional evaluation tools are mainly built around epidemiological indices based on clinical information collected by the Ministry of Health (dengue incidence, suspected febrile dengue cases, laboratory-confirmed dengue cases) and entomological indices based on the monitored presence of potential or active mosquito-breeding containers (house, breteau, and pupa per person indices), or are geared toward economic cost-benefit analysis. While these indices and indicators are effective and important for understanding dengue transmission dynamics and risk in Machala, they do not offer a holistic picture of the determinants of dengue transmission risk in the social, cultural, political and ecological contexts of each community [258].

Equitable community participation is imperative to cultivating a more holistic view of dengue transmission risk, and this extends to developing evaluation tools and informing evaluation processes. Participatory processes seek to include multiple voices and to facilitate their consideration in an equitable manner, therefore, any resulting evaluation rubrics or strategies should focus on both process and performance or health impact [258]. Importantly, experiential knowledge and qualitative information should contribute to the evaluation of both process and impact, rather than the more conventional division of knowledge with quantitative data contributing to impact evaluation and experiential knowledge “demoted” to process evaluation. Participatory evaluation tools and strategies should be
integrative, valuing multiple types of knowledge and using them together to provide a clearer and more holistic picture of impacts, benefits, and success [257].

3.6.4 Indicator development methods
A preliminary evaluation matrix, a tool including multiple indicators and indices for evaluating participatory and community-based dengue prevention and control programs, was designed based on findings and identified themes resulting from qualitative and coding analyses of interview and focus group transcripts. Questions 9 a-d in the semi-structured interview guide (Appendix 3) were specifically designed to gather information regarding project and program evaluation, however, aspects pertinent to participatory evaluation were found and coded throughout the length of the interview and focus group transcripts. Ethnographic observation of dengue prevention and control activities and decision-making processes also contributed indicators to the evaluation matrix.

The preliminary evaluation indicator matrix was shared with and validated by the research team of the EBS-Ecuador project, three vector control functionaries, three neighbourhood presidents and two government administrators; changes were made to wording and one additional indicator was incorporated. Participatory indicator development surveys were designed based on the validated evaluation indicator matrix to elicit Likert-scale value judgments on the importance of each indicator in the matrix (1 = not important, 2 = somewhat important, 3 = important, 4 = very important, 5 = extremely important). The underlying constructivist hermeneutics equate the presence of an indicator in the matrix with the existence or application of the corresponding aspect in a dengue prevention and control program. Draft participatory indicator development surveys were validated by the EBS-Ecuador project research team and a convenience sample of two vector control workers, two front-line health workers, two lay-community members and one government administrator prior to target respondent population sampling. A sample of 120 respondents was determined
sufficient to allow for the illumination of a dynamic present in less than 5% of the population [262].

The recruitment structure of the 120 survey respondents attempted to reflect the relative proportions of participants from identified stakeholder groups in the overall EBS-Ecuador project: sixty (50%) of respondents would be recruited from the community, 55 (46%) would be recruited from various levels of government and 5 (4%) would be recruited from dengue researchers. Five participant communities were randomly selected as the basis for the following sampling scheme: convenience samples of 12 residents, three members of the neighbourhood council, and 3 staff members of the Health Sub-Centre for each of the 5 neighbourhoods; 10 front-line Ministry of Health vector control workers, 15 government administrators from both the Ministry of Health and the Municipal Government of Machala and 5 dengue researchers. Surveys were administered by myself and a trained research assistant from the EBS-Ecuador project, from 18 March – 6 April 2012. At the close of the approximately 15 minute survey, the respondent was invited to one of 5 results dissemination and discussion meetings the week of 25 – 31 March 2012, each at a location within one of the randomly selected neighbourhoods, their intent to attend or not was recorded.

Results of the participatory indicator development survey were roughly analyzed using mean response values to explore overall ranking of importance, and ANOVA (JMP software [263]) to compare mean response values for indicators and indicator categories by stakeholder group. This preliminary data was presented to participants at results-sharing meetings. For those participants who were absent from the meetings, follow up through a face-to-face visit or phone call with the community participants to explore impressions, opinions and evaluate the participatory indicator development process were carried out the following week of 2-6 April 2012. A more elaborate analysis of the indicator valuation survey was done with both principal component and hierarchical clustering analysis using JMP, Version 10 Software [262].
3.6.5 Principal component analysis & hierarchical clustering

Participatory indicator development survey data were analyzed using principal component analysis to reveal, in a data-driven way, trends of indicator importance or valuation as shown through participant responses. Principal component analysis (PCA) digests complex data with multiple dependent variables so that the structure of the observations in that data can be interpreted. Essentially, PCA is a multivariate method of compressing and simplifying a complex data set by concentrating on prominent trends in that set and computing new variables, called principal components, used to describe the data based on the “importance” or percentage of total variation or inertia in the dataset consumed by each trend [264, 265]. Principal components linearly combine the original variables through the use of eigen vectors, in a data set in pairs with sequentially decreasing total variance. That is, the first principle component of a data set would comprise the variables in a data set that when combined would account for the largest proportion of the total variation in the set. The second principal component would comprise a combination of variables from the same original data set that would account for the second largest proportion of the total variance and be mathematically orthogonal to the first; these two components are mathematically at right angles and therefore independent of one another [266]. Principal components can be thought of as axes along which variables align according to their values within the dataset, they are defined by the variables that are associated with the extremities of the axes.

Building on the major trends identified with PCA, hierarchical clustering analysis was used to explore how stakeholder experiences, perceptions and orientations naturally group indicators together and how it may challenge conventional structure and use of evaluation tools. In addition, hierarchical clustering analysis of stakeholders in accordance with indicator valuation profiles was used to explore the validity of evaluation tools and KT models based primarily on preparing and sharing knowledge geared toward various discreet stakeholder groups [267, 268].
Hierarchical clustering analysis is a multivariate technique that groups objects together according to the similarity of data or values relative to other objects. Agglomerative hierarchical clustering is often describes as a “bottom-up” process in which each object, or row of data, begins as its own cluster, then, as determined by distance calculations, these solitary object clusters are grouped with other solitary object clusters that are “least distant” or most similar [266]. The clustering process results in a dendrogram, a visual representation of object and cluster similarity resembling a phylogenetic tree. A final number of clusters can be selected from the dendrogram. This process of hierarchical clustering fits well with interpretivist, participatory methods in that it is data-driven; specifically, the analysis of the participatory indicator development survey is driven by the opinions and valuations of the participants. Agglomerative hierarchical clustering assumes diversity to be inherent in a data set and seeks to find similarity between unique objects. This stands in contrast to divisive hierarchical clustering that begins by grouping all objects together in one cluster and subsequently dividing that cluster based on differences found between groups of objects [269].

Distance between objects and clusters is calculated in a number of ways, Ward’s minimum variance method was used in producing the dendrogram for the participatory indicator development survey data. Ward’s method calculates the distance between two clusters using the ANOVA sum of squares between the two clusters added up over all the variables. Clusters are joined with the objective of minimizing the within-cluster sum of squares and for maximizing parsimony overall in the dendrogram. Ward’s method tends to create dendrograms with clusters of approximately the same size and is sensitive to outliers [270].

Participatory indicator development survey data for tertiary-level indicators in the preliminary evaluation matrix were analyzed using PCA to find major data trends in how respondents valued the importance of each indicator for the overall
sample and within each stakeholder group. Gross category and secondary-level indicators were not included in the PCA to reduce redundancy in the data set due to the nested nature of the evaluation matrix. Subsequent Ward's hierarchical clustering analyses were used to identify groups of similarly valued indicators and groups of respondents that exhibited similar indicator valuation profiles [271, 272]. Descriptive statistics were also calculated within and between stakeholder groups. All analyses were done using JMP software, version 10 [271].

**3.7 Community participation, empowerment & well-being survey**

A community participation, empowerment and well-being survey was produced to fill a data gap identified during data cleaning. The survey was designed to gather information on community experiences and opinions around participation in dengue prevention and control programs, power- and information-sharing dynamics within participatory dengue prevention and control programs in Machala, and human security issues in everyday life (Appendix 2). Five statements regarding community participation were adapted from a Cuban community empowerment and dengue prevention study [269], five statements on community empowerment measures were adapted from an American program evaluation and community empowerment study [270], and five statements regarding community well-being and everyday human security issues were developed from ethnographic observations and the preliminary coding of interview and focus group transcripts. The survey was again designed for Likert scale responses regarding the degree to which each statement reflected the reality of their own experience (1 = none, 2 = weak, 3 = fair, 4 = good, 5 = excellent). The survey was validated by the EBS-Ecuador project research team, three front-line Ministry of Health workers and two lay-community members. The survey was administered to 1888 EBS-Ecuador project participant households by a trained vector control worker or senior health sciences university student during the regular home visit for the March 2012 data collection period for the EBS-Ecuador project.
Community participation, empowerment and well-being survey data were analyzed using i) univariate ANOVA to explore correlations between the Social Insertion Index (INSOC) developed by the EBS-Ecuador project and survey responses, and ii) paired t tests to explore correlations between responses to statements in each of the three statement categories: participation, empowerment and wellbeing. All quantitative data analysis was done using JMP software, version 10 [265].
Chapter 4 – Results: Machala Network Mapping and Analysis

The results presented in this chapter address the research questions regarding who is involved with and affected by participatory dengue prevention and control programs in Machala and how they interact. After first presenting a survey of interacting stakeholder groups, their basic roles, and interactions (4.1.1), I explore some of the present social dynamics that influence the character of their interactions (4.1.2). These dynamics are both produced by and are a product of the structure of the social network, power imbalances inherent to that structure, and knowledge sharing and communication patterns within the network (4.2). This analysis begins to address the second specific research question regarding the effects of stakeholder interactions and perceptions on evaluation, KT and research-to-policy processes.

The presentation of these results is done with the intent to provide valuable and nuanced insights into the specific social, political and cultural context of how participatory dengue prevention and control unfolds in Machala, and how human interactions come to bear on those processes. Local context and experience are crucial to a deeper understanding of how otherwise unexamined, and indeed unobserved, elements of interaction between people, groups of people, systems and larger social dynamics combine in various ways to produce and perpetuate challenges in participatory dengue prevention and control. In section 4.3, I present a series illustrative vignettes describing three different problematics as they manifest in daily engagement with dengue prevention and control in Machala, providing a window through which the intersection of elements outlined in sections 4.1 and 4.2 can be conceptualized more clearly. These results have been crafted through a process deliberately anchored in the Machalan experience to the ends that it be practical, applicable and useful to improving health equity and equitable participation in this specific context.
4.1 Stakeholder analysis

Exploring the social, political and communication dynamics that influence dengue prevention and control policy and programming in Machala through the lens of the people who are involved provides a vivid insight into the forces at work with respect to social determinants and determination of dengue risk and prevention. This perspective provides new layers of understanding of deeper longitudinal processes that reveal social networks of people involved with and affected by dengue in Machala that are fluid, dynamic and far-reaching.

The stakeholder analysis presented here is not exhaustive or final, rather, it is a description of a multi-faceted community of people connected and disconnected by culture, politics, discipline and the social “way that things are” within the specific context of the identified health issue of persistently high dengue incidence and the programs, both current and proposed, available to address it. The aim of this stakeholder analysis is to shed light on how connections between actors within this particular space, time and place may influence how dengue prevention and control decisions, program implementation and evaluation activities take place, how they are valued and what practical impact they may have on the daily reality of the actors involved. The context-specific nature of this chapter serves to focus the results in the light of barriers and bridges to community-based dengue prevention and control efforts and their social and cultural determinants in Machala.

The stakeholder universe is defined as all of those actors who are affected by, involved in or associated with community-based dengue prevention and control services, programming and policy in Machala, Ecuador. To recap the main points of the full description in Chapter 2 of this thesis:

i) Dengue fever is a viral mosquito-borne disease that is transmitted by the anthropophilic mosquito vector *Aedes aegypti*, and for which no vaccine or specific treatment exists. Thus, the only “cure” for this
disease of major public health concern is prevention which is most effectively done through mosquito control and personal mosquito bite prevention methods

ii) An environmentalism movement in the face of environmental chemical contamination and mosquito insecticide resistance has changed the focus of mosquito control strategies from insecticide use to mosquito-source reduction campaigns and integrated vector management. Insecticides are still used as part of these programs and in periods of imminent risk of epidemic dengue transmission

iii) Because *Ae. aegypti* is an anthropophilic mosquito that oviposits in clean water, the mosquito larvae sources of highest interest are water storage and rainwater filled containers in and around the home. These containers produce mosquito vectors in close proximity to a susceptible human population

iv) Source reduction, dengue education and community mobilization campaigns are targeted at mobilizing residents to eliminate vector-breeding habitat in and around their homes. Although it is widely understood that lack of basic sanitary infrastructure and services are major determinants of dengue risk, addressing these issues is almost never included in dengue prevention strategies

v) Monitoring and evaluation is done through epidemiological and entomological indices. Epidemiological data is gleaned through the existing Ministry of Health disease registry, while entomological data is collected through door-to-door canvassing by Ministry of Health vector control brigades that enter private residences to count and record numbers of immature mosquitoes and numbers of water-filled mosquito breeding sites. These numbers are reported back to the Ministry of Health and the National Arthropod-borne Disease Control Service (SNEM) to evaluate the impact of implemented dengue strategies
4.1.1 Identified stakeholder groups and actors

The four basic stakeholder groups established at the outset of exploratory ethnographic observation were “Community”, “Government”, “Research” and “Private Sector”. These categories were refined through the data cleaning and analysis process to include sub categories based on function and social location within the network (Table 7). Importantly, the refining of stakeholder sub-groups was prompted by recurring themes in the interview and focus group data: strong hierarchy and paternalism within government structures; a clear division of political will and responsibility between government entities and distinct perceptions of prescribed roles of these different groups in community-based dengue prevention and control efforts.

Stakeholder analyses explored the relationships of stakeholder groups to one another, to the problem of persistently high dengue incidence and the proposed EBS dengue prevention and control program, stakeholder objectives and impacts. The results are summarized here and complete stakeholder analysis matrices can be found in Appendix 4.
Table 7 – Stakeholder groups, sub-groups and examples identified through ethnographic observation and interview/focus group data collection

<table>
<thead>
<tr>
<th>Gross Stakeholder Group</th>
<th>Stakeholder Sub-Group</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community</td>
<td>Community</td>
<td>Residents, community groups, churches, child-care groups, community policing groups, active community members, community block associations</td>
</tr>
<tr>
<td>Government</td>
<td>Local Government</td>
<td>Neighbourhood Presidents, Neighbourhood Councillors, Neighbourhood Voices, Multi-neighbourhood Council Coalitions, Parish Unions/Councils, Parish Councillors</td>
</tr>
<tr>
<td></td>
<td>Government Functionaries</td>
<td><strong>Municipal</strong>: Police officers, Community policing officers, Health Commissioners, Health inspectors, nurses, doctors, garbage collectors, drivers, public works employees</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>SNEM</strong>: Public Health nurses, field team coordinators, statisticians, IT specialists, entomologists, biologists, brigade chiefs, vector control staff, drivers, warehouse and equipment managers</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Ministry of Education</strong>: Teachers, teaching assistants, school maintenance workers</td>
</tr>
<tr>
<td>Government Administrators</td>
<td>Municipal</td>
<td>Mayor, Deputy Mayor, Municipal Councillors, Municipal Department Heads</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>SNEM</strong>: National Director, Regional Directors, Epidemiologists, Regional coordinators, Program Directors</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Ministry of Education</strong>: National Minister of Education, Provincial Director of Education, Regional administrators</td>
</tr>
<tr>
<td>Research</td>
<td>Researchers</td>
<td>UBC professors, UBC graduate students, UASB professors, UASB academics, UASB staff, UASB graduate students, UTM professors, UTM students</td>
</tr>
<tr>
<td>Private Sector</td>
<td>Private Sector</td>
<td>Triple Oro water utility</td>
</tr>
</tbody>
</table>

4.1.1.1 Community

Community stakeholders are by far the largest group in the study. With 2000 households and approximately 4.5 persons per household population density in Machala, there are an estimated 9000 residents who are directly involved with the EBS-Ecuador project.
Household participants, or residents are considered within the social network in several ways:

1) as the source of knowledge and experiential understanding of how and why health, security and the absence of either or both exist and persist in communities

2) as the holders of narrative, culture and story that shape conceptions of health and that affect the acceptability, appropriateness and effectiveness of health interventions

3) as the recipients or audience of KT cycles, health and sanitary education, and recipients of services (i.e. garbage collection, vaccination campaigns, water and sewer, paved roads, vector control)

4) as the information base for epidemiological data collection and investigation into dengue transmission risk and effectiveness of control efforts

5) as the basic electoral unit for geopolitical systems

6) as barriers to or facilitators of effective dengue control

Communities, neighbourhoods and their residents are often lumped into a single stakeholder entity, but of course, this leads to loss of richness in this diverse body of actors. There are myriad experiences of dengue and dengue prevention in Machala, all of which are affected and determined by social, cultural, political and economic dynamics in their neighbourhoods; these dynamics vary widely between and within the bounds of each of the 20 participating neighbourhoods.

Communities and their elected local governments or neighbourhood councils are historically considered as unified entities. Professional and political norms within the Ministry of Health, the National Arthropod-borne Disease Control Service and the Municipal Government reinforce this idea, as appropriate community collaboration is nearly always coordinated through Neighbourhood Presidents. However, relationships between participant communities and their neighbourhood councils in this study ranged from open conflict and
acknowledgement of corruption, to a sense of community apathy, to trust and collaboration, to investment in social action and community empowerment in solid partnership with one another\(^1\). Because of the varied and diverse nature of these relationships and the implications they hold for community-based dengue prevention and control initiatives, neighbourhood councils or community governments were regrouped into the Local Government category.

“Truly, I have seen that here in [our neighbourhood], we like to work for our community. But what happens is that we have this gentleman who still acts as President, but he no longer is President. Because we, the past presidents here, called a meeting to name the new neighbourhood council. Nobody attended, so now we say that we are the new council, and that’s that, and here we stand. So he was President, but he is no longer… recognized. The people don’t really care for him. So, for example, this is why yesterday there wasn’t good attendance like you had hoped [at your project meeting], because he said, ‘meet at my house’.” – Community resident focus group participant

There is a pervasive sense of “desunion” or lack of unity within the 20 participant neighbourhoods; this persists to some degree even in neighbourhoods that have cultivated a relatively high level of social cohesion and mobilization. In some cases it is a mistrust of the elected Neighbourhood President or members of council; in others it is a sense of apathy toward the concept of community and toward neighbourhood initiatives.

“I mean, when something happens to us, nobody does anything. I mean, others don’t care. Let’s say our neighbour is about to die of dengue. Over there, they are happy and fine. So this is what happens, right? I mean,

\(^1\) The particular examples of the extremes of the relationships of communities to their neighbourhood councils should be considered in the context of their own historical narrative rather than as a static, permanent state of being. The neighbourhood in which there is open conflict and public acknowledgement of corruption on behalf of the neighbourhood council has experienced a long history of “bipartisan” struggle between groups that have become and continue to become entrenched and divided; so much so that they are considering a social split within the neighbourhood. The neighbourhood whose relationship to their neighbourhood council is characterized by social mobilization and equitable representation and collaboration is only newly experiencing a surge in social capital and motivation after a long period of division and conflict. This neighbourhood is mobilizing to address their self-defined health issues, not the least of which are environmental improvement, crime reduction and community security.
there is no unity. There is no community effort, there is no way to work together.” –Community Focus Group

“We have to seek out someone on each block who could facilitate contact with the residents of their street, someone who could speak on the needs and interests of their neighbours on whatever the issue may be. So, if this new social fabric is not constructed the issues will go out the window. We have to build a new social fabric to begin to communicate identified needs, so the community can learn about and find solutions for their own issues, and so the function of the state becomes to complement and respond to community action.” –Community President Interview

The mistrust of neighbourhood councils and political connections within neighbourhoods also permeates inter-neighbourhood relations as a sense of mistrust and suspicion toward other neighbourhoods and Municipal authorities. The City of Machala is marked by weak public infrastructure and short-handed basic services; however, this is not a uniform pattern. There is a heightened awareness of political corruption (with deep historical roots) as part of governance culture and resource allocation in Ecuador that manifests as inequitable distribution of resources [110]. In the centre of the city there is a concentration of wealth, infrastructure and services, with many regeneration and gentrification projects underway and recently completed to “revitalize” the city’s core. Paved roads, good lighting, improved sanitary and storm sewers as well as reliable piped water provision and routine municipal garbage pick-up are commonplace and expected in central neighbourhoods. The general trend is that concentration of wealth, presence of infrastructure and provision of basic services decreases as neighbourhoods become increasingly distant from the city centre. This trend is often referred to as “Centrismo”\(^2\), a politically motivated bias

\(^2\) In Machala, the concept of Centrismo is also tied to a palpable sense of political corruption for the benefit of business and industry over the welfare of the citizenry. City centre revitalization efforts and renovation of roads, parks, street lighting and storm sewer systems were referred to by community residents, local governments and some government practitioners as ways to attract international industry to benefit governments and already wealthy tycoons rather than invest in infrastructure that would improve the health of many. From 2011 to 2012, a large infrastructure project was begun and completed to improve the highway and entrance to the South end of the city. This is the main route for moving goods and equipment to and from Peru, and to and from the airport; there were frequent traffic jams until the main highway was doubled, a new south-westerly entrance highway was added, and new under and over-passes were built. The south
toward the urban centre that is seen to be driven by business and social connections. Neighbourhoods on the periphery of the city, particularly neighbourhoods in the North, are not reliably connected to the municipal water network, lack paved roads and have little to no access to adequate sanitary and storm sewerage. Water provision and quality are major concerns and residents often opt to buy and store potable water in their homes, sometimes at significant expense.

“The water is of poor quality, and in some places they don’t have access to water. So, they need to use tankers and store water. I mean, even those who have water have to store water because [what they have] is no good.” – Government Functionary Focus Group

Many of these neighbourhoods are characterized as “invasions” or “invaded spaces” by public health workers and government administrators. These neighbourhoods were “unplanned” in the sense that they were not officially sanctioned by previous Municipal Governments who took a “permissive” view to settlement of the peri-urban areas. Globalization and rapid urbanization are major drivers of human migration and settlement in Ecuador; these neighbourhoods are characteristic of how agroindustry and aquaculture have shifted demographic, social and epidemiological profiles on Ecuador’s southern coast [265, 273, 274]. Communities and neighbourhoods grew on land that was once used to farm shrimp; large, deep depressions or basins framed by unpaved dykes without any of the required provisions for sanitary infrastructure or basic services. These neighbourhoods are often characterized as low socio-economic class with lower human security indicators. Part of the rhetoric surrounding the need for basic services in these areas revolves around institutional denial of

end of the city has become a haven for developers in the last decade. Many new gated communities, shopping malls, tourist complexes are under construction and planned for this area. These recent municipal investments of infrastructure in the urban core as well as in areas to attract development reinforce the strength of this cultural dynamic as well as the experiential knowledge held by communities of the destructive power of corruption and corrupt motivations.
responsibility based on historically permissive and irresponsible Municipal
Government administrations that allowed these spaces to be invaded.

“But maybe they should also address the invasions from the previous era. Before, during Minuche’s time, it was more permissive for people to establish invasions wherever they liked. So they were invading in the city centre and everything. Not anymore, now they are stopping the invasions. Because an invasion there damages everyone’s health” – Government Functionary Focus Group

“They don’t have basic services, and there are various neighbourhoods that were created in areas that used to be shrimp farms. To do that [farm shrimp], they had to dig the ground level down. Always when it rains, they always present with dengue. Vectors, like mosquitoes, will always appear in these neighbourhoods, even with a little rain, water always accumulates and stands in that kind of place… places that were shrimp farms. So, ground level there is much lower. Ground level is between five and six meters lower than sea level. So, when it rains, it will always be like that. Those are the people that need… they are always demanding land-fill [to raise the ground level].” – Government Functionary Focus Group

The concept and discourse of “invasion” provides the context for institutions to shirk responsibility, and to place it on the residents themselves, the overtones of invasion rhetoric imply that the residents of these communities have earned the unjust situation they find themselves in through the exercise of their choice to settle and continue to live in a particular place; in essence, blaming the victims of displacement and homelessness for their social problems. Interestingly, there is an implication of the nature of these settlements as temporary, although in many cases families have been living there for three or more generations. This attributed temporary nature serves to undermine the importance of place and history for these communities, to whom the authorities offer the sustainable

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3 I explored the dynamic of the invasion rhetoric that attributes “temporary” nature to these neighbourhoods at a meeting with a group of neighbourhood presidents that had formed a coalition to advocate for neighbourhoods in the North of Machala. With representatives of 6 neighbourhoods participating in the meeting, there was an overwhelming consensus that the majority of these neighbourhoods had been in existence for at least three generations, some for more than four. Despite the history of these communities and the family, neighbourhood and cultural roots there, authorities persist in the rhetoric of temporary invasions and unfortunate circumstance.
“solution” to their problems of relocation to avoid flooding, health problems and issues of security.

“Nevertheless we, as residents, continue to demand improvements. But [they say] how can they plan here? Yes, they invite us to move to another place for a better life, don’t they? But, often, like my neighbour says, we are indignant and we don’t want to leave. Nevertheless, we demand.” – Community Focus Group

Unfortunately, under current practices of Municipal and SNEM vector control, this lack of infrastructure also directly results in a lack of services in that insecticide fogging vehicles have been documented to only provide these control services along paved streets in the wet season. Garbage collection does not pass down every street in a neighbourhood, with smaller, unpaved streets being missed. In many of these neighbourhoods, crime and lack of public security is a palpable force in the decisions people make. Home invasions, break-ins, street violence, muggings, drug trafficking, and the sex trade are daily concerns far more common in peri-urban neighbourhoods than in urban neighbourhoods in Machala. In some of the more impoverished neighbourhoods where gang violence and drug trafficking are of particular concern, it has become a barrier to service delivery for vector control and other public health campaigns as well. Vector control and health workers become victims of this violence if they enter into these neighbourhoods unaccompanied by police. It is commonplace that residents in these neighbourhoods will not allow access of personnel to their homes because of fear of crime, violence and corruption. This again contributes to the feeling of abandonment by both the Municipality and the Provincial Government and its ministries, and mistrust between neighbourhoods and government.

“Well, apart from that, other problems that are of note here in the city [Machala], and in the province as well as Ecuador, is the lack of security. In reality, this is a serious problem for us.” – Key Informant Interview
“The lack of security we face... as a part of the community, as members of our families, we face threats of possible robbery, people that are paid to do crimes. In this sense, I am talking about social insecurity that we life with everyday.” –Key Informant Interview

The lack of unity and security experienced by many residents and neighbourhoods in general, combined with the lack of infrastructure and sense of political abandonment manifests as part of the cultural dynamic of “Quemeimportismo”; a pervasive sense of the futility of striving to improve conditions under the oppressive thumb of corruption and social issues. This is just one facet of the complex dynamic of Quemeimportismo (loosely translated as “an attitude of why should I care”) that I will explore in subsequent sections. This dynamic is woven intricately into the rhetoric around community health and social justice, and it is crucial to acknowledge that each stakeholder group engages with the dynamic differently.

Community participants experience Quemeimportismo both as a personal attitude and as an orientation to participating and collaborating in improving community well-being; it is “revealed” within the community context, and therefore reinforced, through the observation of inaction of individuals and groups of individuals to engage socially and politically in neighbourhood governance, public spaces and movements to improve the community environment and community health.

“They don’t care. The Quemeimportismo [apathy] here begins in childhood. When we get sick, we say, 'now come give me this, this and this.' But meanwhile, we do not care for ourselves in the same way. We have to care for ourselves.” –Community Focus Group Participant

The perception of Quemeimportismo does not exist in a vacuum, nor is it applied evenly across neighbourhoods or groups of residents. The essence of an engaged community runs through the core of the discourse around frustrated community collaboration and grassroots social mobilization. Certainly, this research in and of itself would have been impossible in the absence of abundant
willingness to collaborate and enthusiasm for social action within these
neighbourhoods. The cultural dynamic of *Resentimiento Social*⁴, or social
resentment, comes hand-in-hand with *Quemeimportismo*. Social resentment
carries the connotation of a visceral experience of living with the abject
consequences of corruption and political neglect. *Quemeimportismo* is often a
label that is applied to others, a rather undesirable characterization of poor social
behaviour; whereas Social Resentment is akin to a social movement and political
statement pushing back against paternalism and corruption that is adopted or
defined autonomously.

Social Resentment manifests in similar ways as *Quemeimportismo*, and to an
uninterested observer may appear the same. Peaceful resistance and non-
cooperation with paternalistic programming and service delivery, challenging
victim-blaming rhetoric and insistence on equitable access to infrastructure,
services and political agency are hallmarks of Social Resentment, hearkening
back to Bolivarian revolutionary principles, a history of resistance and cultural
identity that runs deep in Ecuador [90, 275]. These forms of resistance to a
paternalistic state are often misconstrued as “bad behaviour” and disinterest in
participating in efforts reduce dengue transmission and *Aedes* indices.

### 4.1.1.2 Local Government

As discussed in the previous section, the local government stakeholder sub-
group was created within the stakeholder universe primarily to accommodate the
diverse relationships communities have with their neighbourhood councils.
Secondarily, Parish Unions and entities not belonging to any National or

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⁴ The term *Resentimeinto Social* was first used in the context of this research at a results-sharing
meeting and workshop held at the conclusion of the first year of the EBS-Ecuador project that
held space for dialogue between all stakeholder groups involved. A spokesperson for a coalition
of neighbourhoods brought this concept forward during a dialogue session geared at deepening
understanding around the cultural dynamic of *Quemeimportismo* as it pertains to community-
based dengue prevention and control programs, the proposed intervention for the EBS-Ecuador
project and the challenges with equitable community participation. This emphatically
demonstrates the value of participatory action research in that it is transformative for both the
community and the researcher. Importantly, this opened an unexpectedly productive vein of
dialogue in which many of the other neighbourhood representatives and community resident
participants added to the clarification and definition of the realities of both cultural dynamics.
Provincial Ministries, or to any branch of the Municipal Government of Machala were also grouped here. Although neighbourhood councils share a much more intimate relationship with community residents than do Parish Unions or multi-neighbourhood council coalitions, they all serve in ways that mediate information flow to government administrators, health service delivery, vector control activities and facilitation of equitable community participation in community-based dengue prevention and control initiatives.

Neighbourhood Councils and Presidents are considered within the social network as:

1) gatekeepers for access to the community in terms of service provision, epidemiological surveillance and monitoring, social mobilization and community health programming
2) negotiators and liaisons between neighbourhood residents and Provincial Ministries (Health, Education, Environment) and the Municipal Government and its departments (Public Works, Health, Police)
3) coordinators and community organizers
4) representatives of the community’s interests
5) helpers or hinderers of the community’s objectives, this is judged based on perceived corruption, honesty and dedication to community work

Neighbourhood councils are democratically elected to represent the interests of their communities once per year and are comprised of a president, vice president, treasurer, secretary, coordinator, and five principal community voices and five assistant voices that speak to the council on the residents’ concerns and interests regarding health, environment, education, sports and culture. Each member of the council is elected to his or her respective post by democratic ballot. These councils act primarily to coordinate activities and efforts within the communities themselves and to liaise with other government entities regarding issues the community may have. For example, neighbourhood councils routinely coordinate yearly celebrations for the anniversary of the founding of their
neighbourhood, organize soccer tournaments, collect signatures on petitions to improve infrastructure and policing, organize community clean-up efforts, coordinate community health days with the Ministry of Health, and vector-control and insecticiding services through SNEM. Each neighbourhood in the study, as is commonplace in Machala, had a “casa communal” or a neighbourhood hall that serves as a meeting place, but also often houses day care centres, seniors programs, sports programs and health education days. The budgets that the neighbourhood councils manage are small and are generated from fundraising within the community itself via small events such as barbecues and bingos. There are very rarely, if at all, any funds received from other government authorities or official sources.

“Here when we notice that the patios in the neighbourhood are cluttered, dirty and full of weeds, and the weeds in the streets are growing, we organize ourselves and put together a minga5 and clean everything up together. I mean, this is how we try to help ourselves.” –Neighbourhood President Interview

Neighbourhood Presidents carry the most weight and are the most visible of all the members of the council. As the main liaison for the neighbourhood with other government entities, Presidents are often in the precarious position that comes with bearing heavy responsibility with little to no authority to make decisions or mobilize resources. They are often at the mercy of the unpredictable ebb and flow of political will and available resources, which can be mediated by political and personal connections to points of contact within Ministries or the Municipality.

5 “Minga” is a Quechua word used in Machala to refer to a community-organized clean-up effort. Mingas usually last a full day and involve coordination with the Municipal Government of Machala for provision of a dump truck, driver and a few sanitary workers. Neighbourhoods in partnership with their councils, will set a date and time for the minga, with door-to-door or megaphoned reminders for each family the night before it is to take place. The truck arrives in the morning passes through the streets where each family will have removed everything from their patio that is garbage, broken or out of use. Any junk or abandoned articles in public spaces are cleaned up and weeds are cleaned from patios and unpaved streets. The truck and personnel are provided free of charge by the Municipality to the communities, however, they must provide the gasoline for the trucks and usually a meal for the personnel. Mingas are an essential part of community health, particularly in areas where Municipal garbage pick-up is unreliable and there are no services to remove large items from homes.
“I have been involved with this for six years with [my neighbourhood]. Just a week ago we had a meeting with the Deputy Mayor. We have a good relationship with the Municipality, they have helped us a lot here too.” – Neighbourhood President Interview

“The subject here is land-fill. I have said a number of times, and now I am afraid to continue lying, ‘Now we are going to fill this [depression] in. We are going to fulfill the petition with the Mayor to fill it in.’ So, the people believe that now the Mayor, because we have already completed the official steps, that now the Mayor will come and fill it in. Then nothing happens and a month later people come to see and it is the same. And you said that they were already doing it. So, now I am a bigger liar! This is a terrible way to deal with things! It’s terrible for the neighbourhood councils, for us not to have the response we need [from the Municipality].” – Neighbourhood President Interview

As gatekeepers and representatives for the communities, Neighbourhood Presidents and their councils are instrumental in supporting and facilitating social mobilization and organization within the community. Following the rhetoric identifying the dynamic of Quemeimportismo as a major barrier to health, security and progress in communities, the solution or best-case scenario often posed is that the community ought to organize and mobilize itself. From the perspective of community stakeholders, organizing offers them a clearer political voice that has a better chance of being heard by authorities and decision-makers which, in turn, gives them a better chance to work to address their identified issues. From the perspective of government administrators, decision-makers, service providers and data collectors, an organized community is seen as one that will collaborate more willingly, more readily provide access to private homes, transmit messaging more effectively and comply with directives. From both perspectives, organization is seen as community empowerment, a means to build trust, improve both health and elements of human security, and as a crucial step toward addressing identified issues expediently.

“The classic example of what happens with policy in our country, and I think in all of Latin America, is that they don’t listen to you any further than required for political affect. This takes the problem out of the community’s hands… so the problem then only serves for the gaining of political affect.
I think that our communities have a deep responsibility to mature ideologically so that we can begin to define our problems together and ensure that our concerns are heard.” – Neighbourhood President Interview

“So, we’re Neighbourhood Presidents, right? Then it shouldn’t bother us to walk door-to-door. For me, it would be great if there were [officials] going around, that they always begin with the Neighbourhood President. Then there would be good communication and someone that I could count on. Above all, this would be a really great help to maintain everything in order. I mean, practically, to finish with this disease [dengue]. Well, it’s not to say we will finish, but that we will simply control it so that mosquitoes won’t breed.” – Neighbourhood President Interview

“They [communities] have to be organized. This is one of the most important factors, to be… to have a committee for health organized from within and to form a directive group. So that they can connect and be involved directly with us.” – Government Functionary Interview

The City of Machala is divided into eight Parishes, or districts, each of which has an elected governing body called a Parish Board. These boards act in both a liaison and an administrative capacity, they advocate for the neighbourhoods in their district for services, infrastructure and other issues to the appropriate municipal or ministry authority. Parish Boards also interface with the Provincial Prefecture and Provincial Council on various matters; however, these are not emphasized as important for dengue prevention and control programs and activities within the social network. Of the eight Parish Boards that belong to the social network, only the board of the Parish that is entirely peri-urban/semi-rural was active in the negotiating of vector control services, health days and dengue prevention activities. In the urban parishes, these services and activities were coordinated directly through Neighbourhood Councils.

This phenomenon is of particular interest when considering the dynamic of Centrismo and decreasing political visibility with increasing distance from the city centre. Because of lower population density in this semi-rural parish, eight adjacent neighbourhoods were recruited and combined into one cluster in order to fulfill the requirement of 100 participant households. As a result, these eight
neighbourhoods were fit into a structure convenient for researchers and administrators, there is a Ministry of Health sub-centre serving the parish as a whole, while reducing the interface with individual neighbourhood political representation. The research process, decisions made regarding vector control and health services, as well as the delivery of those services were the result of very limited direct contact was had between researchers, administrators and neighbourhood councils.

“There didn’t used to be the laws that exist now, including for budgets, for programs, for planning ordinance and local development. Now they have to collaborate with citizens, because of the new [citizen participation] law, right? The National Government is bringing this in, I think for the coming year 2012, and there will be much closer coordination enforced, you could say, because of the law. I believe it will be very beneficial for our community because now resources will come our way, because we are the most neglected.” –Key Informant Interview

This aspect of the relationship between these semi-rural neighbourhoods and their Parish Board is considered beneficial in that the residents enjoy the security of political agency through their Parish Councilors without having to depend on each of the neighbourhood presidents to travel the 30 minutes into the city to act on their behalf. From a systems point of view with a perspective on equitable community participation, this reduces the number of connections in the social network in that region with respect to decision-making, service delivery and evaluation. Rather than eight presidents each facilitating participation and decision-making for their own neighbourhood, political agency and community voice is filtered through a single person who may or may not resonate with the lived experience within each neighbourhood context.

“Here political action, before these new laws, has always been directed toward friends, toward people who are well-off financially, and so there was no legal recourse to demand they work with the entire community. And above all, with the most needy, because in the past there were no resources to balance out the inequity, right? I mean, truthfully, the society that is neglected will always be malnourished, will be sick, and will have problems with the same authority that is, shall we say, leading the
community. So, I believe the best investment is in people. The best investment is in the communities that are vulnerable.” –Neighbourhood President Interview

The diminished amplitude of voice through this filtering of experience may, on a political level, serve to further marginalize these communities through reduced political visibility. Although the Parish Board is relatively highly active and is trusted by residents in both its advocacy and administrative function, in-person political representation is essentially reduced to 1/8 of the norm when compared to urban neighbourhoods.

4.1.1.3 Government Functionary

Just as local governments serve as the interface between communities and the political structures and processes for dengue prevention and control policy decision-making and program design, government functionaries serve as the interface for program implementation, data collection and service provision.

Government functionaries are considered within the social network as:

1) the face of government programs and services, allies who care for communities and their health, and who provide an interface or access point to communication with the government in terms of voicing experiences and receiving official information

2) single-minded technicians who follow orders within government mandates rather than respond to community needs in the moment

3) the basic tool for service delivery and data collection for government programs and program evaluation

4) a valuable pool of human resources upon which the success of programs deeply depends.

5) trusted agents of change and sources of important experiential evidence that ought to guide program design, implementation and evaluation.

This broad group of stakeholders includes actors with varying degrees of day-to-day decision-making power, but that lack the power to make decisions that would
affect program design, implementation or service delivery schedules and methods in a broader capacity. From this perspective, the position of the government functionary is a source of frustration as they are charged with the responsibility of meeting the needs of communities through mandated activities that are often seen as insufficient by the residents they interface with.

“We are not opposed to the doctors, but we are opposed to the system, the way in which the system operates, right? The health system. But in reality, health professionals are the most reliable source of information for our community.” – Neighbourhood President Interview

“I think that one of the first duties [of government] would be to do something, but not half-measures. If they do something complete, if you invest in a program or if we are going to try to achieve something with it, we have to follow through. Because this is one of the biggest problems in our country.”

Lack of intersectoral coordination between entities for service delivery and program implementation leads to community fatigue and to frustrated efforts to improve community health. Enforcement of health by-laws, or the lack thereof, is also a source of frustration for these groups. There is a sense of futility in their duties as public health workers when there is a perceived lack of political or institutional willingness for addressing dengue risk and sources of dengue transmission that fall, often unattended, into the intersectoral abyss. Vector control and Ministry of Health government functionaries frequently interact face-to-face with neighbourhood residents, and therefore receive most of the feedback as it relates to public health problems including dengue. Some of the health problems, such as inaccessible abandoned lots harbouring mosquito-breeding sites are beyond the legal and political mandates of the Ministry of Health and SNEM; these workers are unable to directly act to address these problems. For example, complaints regarding lack of infrastructure or municipal garbage pick-up services cannot be directly addressed by a health inspector that works for the ministry; a complaint about waiting times in community health centres cannot be addressed by vector control workers.
“Sometimes the Municipal Government will enact a program without talking with us. So, this as well, I mean the lack of intersectoral coordination, does not help us progress.” – Government functionary focus group participant

This frustration contributes another layer to the socio-political context of Quememimportismo. When residents voice their concerns and ask government functionaries to address pressing issues that affect individual health and security in their neighbourhoods and repeatedly receive no clear response from the appropriate source the sense of abandonment and futility in increases. Government functionaries experience complaints directed to inappropriate governmental entities as a level of disorganization and apathy. When community issues that have been repeatedly brought to the attention of government functionaries and authorities persistently go unaddressed, community participation suffers. Poor intersectoral communication and collaboration, even if it is relatively isolated with one sector, can have a significant effect on relationships between neighbourhoods and all sectors of government.

“It is also a little do to with their Quememimportismo, the fact that they think that the Ministry of Health has to do everything for them, and that they don’t have to do anything.”-Key Informant Interview

“La Malaria⁶, well we make an effort, but the community doesn’t. So, what we have is that I have now worked with La Malaria for eleven years, and for eleven years I say [to residents], ‘Please, don’t keep containers, don’t keep them.’ Eleven years, always repeating, and I come back to the same house and again I find containers.”-Key Informant Interview

“[The vector] reproduces in the home in containers and tins. The community has become complacent; many residents don’t see the problem as coming from within their own neighbourhoods. They only see it as an outside issue. Despite this, we take every precautionary measure. We have worked five years within this institution, and some cases, we are still doing the same routine. We continue with the same routine and we want to change that.”-Government Functionary Interview

Government functionaries are very often overworked, as there is a chronic public health human and economic resources shortage in Machala. There is a

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⁶ The Machala office for SNEM is often referred to as “La Malaria”
sentiment within the dengue prevention and control network in Machala of a
gargantuan burden of work for a relatively small pool of people. During the
course of this research and that of the EBS-Ecuador project, many public health
functionaries volunteered unpaid hours to attend community meetings and
support dialogue around improving community-based dengue prevention and
control. At a deeper level, there is significant social pressure for public health and
health workers in general to work unpaid overtime hours. Understanding that
there is no budget to increase wages or hours, and in the face of persistent
health issues, there are unjust expectations for government functionaries to work
under sub-optimal conditions. This is true, as well, for lack of equipment, supplies
and adequate facilities needed to perform their duties.

“Many of my co-workers are in the wrong profession because, for
example, there is no way to oblige health sub-centre staff to work past
4:00 pm. Sub-centre personnel are very difficult; they say, ‘No. I work until
4:00 and not one centimeter more.’ So, I think that we need to change this
part, you see. I mean, the Ministry of Health ought to change it. We ought
to try to change our personnel in health, above all; to train doctors, train
nurses and train everyone with a vision and focus on community health.” –
Key informant interview

“I mean, of course it could have to do with Quemeimportismo in the
people. But also, I think that the Health Team could do more for [the
issue]. But, sometimes, we are very few people and we have so many
programs to work on in the community and so many things to do. There
just isn't enough time.” – Government functionary focus group participant

“It is like I said. Every year we will have dengue and we will have to work
on it whether we like it or not, because there will always be cases and now
we know they will occur year-round. So, we have to keep working year-
round. So that means that resources must be available year-round as well.
Sometimes we have problems with resources, the issue is mobility. Above
all, dengue will always require health teams to travel to affected
neighbourhoods to work, many of which are far away from the health
centres. Our colleague here has had to walk there many times in the rain,
I mean, we really don't have the ability to provide rain protection and in the
rainy season it is worse. You know in many parts of Machala the streets
are unpaved and many of them are just dirt. Despite this, you have to get
to it as best you can. We don’t have the ability to equip our health center
workers well, with protective equipment like boots. Sometimes we get
hurt.” – Government functionary focus group participant
4.1.1.4 Government Administrators

This group of stakeholders is the most powerful in the social network in terms of decision-making ability for program design, implementation and evaluation protocols, valuation of knowledge and policy. In terms of community-based and participatory dengue prevention and control strategies, this stakeholder group can be divided into two broad categories: ministerial, those administrators belonging to the national-provincial-regional governmental ministry hierarchy; and municipal, those administrators belonging to the Municipal Government of Machala under the authority hierarchy of the Machala Mayor’s office. Regardless of the concentration of overall decision-making power with this stakeholder group, there is absolutely an unequal distribution of power within this group. Hierarchical authority drives political processes within these groups, and as such regional administrators have less power than provincial, and provincial less than national. This top-down power structure is a strong determinant for communication, messaging and policy change.

Government administrators are viewed within the social network as:

1) leaders with political vision for the benefit of citizens who are taking steps, to the best of their ability under current political and economic restrictions, to work practically to make positive changes in the lives of the people
2) out-of-touch bureaucrats who have lost the ability to understand the reality of life for the everyman in Machala, and who do not care to step outside their comfort zones, or offices, to understand the practical implications of the policies they make
3) As the governors of the most reliable channels through which to affect social and political change
4) As civil servants who struggle to provide adequate infrastructure and services under restrictive economic conditions, while simultaneously trying to grow industry and investment in their sector
An Eco-Bio-Social focus on participatory or community-based dengue prevention and control programs demands the consideration of environmental and social determinants of dengue transmission risk in Machala. In this city marked by weak infrastructure, human resource shortages and a restrictive economic climate, the glaring issues of patchy provision of piped water, sanitary and storm sewer networks, paved roads and garbage collection stand at the forefront of rhetoric and dialogue. The persistence of these problems, for many in the social network, is a source of tension and of division; they may also provide opportunity for roundabout finger pointing in the absence of strong operational intersectoral spaces for Ministry-Municipality collaboration.

There is a clear division of labour and tasks for current dengue prevention and control strategies in Machala, with SNEM, a division of the Ministry of Health, taking the larger share of the responsibility for anti-dengue activities and programs. SNEM dengue programs run year-round and are embedded within the primary care, community health and epidemiology systems in place with the Ministry of Health. This means that SNEM responds to cases reported through MoH primary care, partners with MoH epidemiologists to track transmission and prevent epidemics and constantly monitors Aedes vector indices.

“The majority of vector breeding sites are disposable containers, or garbage, and garbage collection is poor. Aside from that, the Municipality must take control of the water utility and water provision. If they don’t do it, people will continue to have containers.” – Government Administrator Interview

“The central government does not give [those funds] to the Municipality of Machala because there is a company in charge of administrating [the water utility]. So, those funds do not come to us. We can’t petition for potable water, for sewers. We can’t.” – Government Administrator Interview

SNEM has high visibility within the community; workers are often seen in neighbourhoods and permitted to enter homes for control activities, while the Regional and National Directors are often seen on television, at community meetings and in local newspapers reporting on dengue risk and advocating for
better control. SNEM is well trusted as an institution, and some of this trust is attributed to the visibility and track record of the Regional and National Director.\(^7\)

“Let’s take the example of the [Provincial] Director of Health in the city centre. The Director of Health has never gotten to know peri-urban neighbourhoods. Never. A Director of Health has never come here. Instead, the Doctor from SNEM has always come to give talks, the Doctor from our Health Sub-Centre, and the Director of SNEM. He has come. As for the rest of them, I don’t know of anyone else who has come.” – Community Focus Group Participant

SNEM also has the added “benefit” of not being responsible for public works, garbage collection, policing or other services that negatively impact health and exacerbate dengue transmission risks in Machala. This may provide SNEM with the opportunity to gain the trust of neighbourhoods and local governments in terms of the advocacy for improved infrastructure and basic services as necessary for improved neighbourhood health. The other advantage that SNEM, and the Ministry of Health in general, is singleness of purpose. While SNEM and the MoH can focus their efforts entirely on health and health programming, the municipal government must address a multitude of issues on a restrictive budget, most of which can be viewed through a community health lens.

Although collaboration between the Municipality and SNEM (MoH) exists, it is not at the level that would facilitate integration of services, collaborative program design or complementary agenda setting. The Municipality routinely participates in community clean-up efforts, provides transportation support for SNEM brigades when possible and is open to finding ways to improve intersectoral spaces. The Municipal Health’s dengue prevention program is seasonal, relatively small when compared with the coverage that SNEM provides and is

\(^7\) In October 2013, the Regional Director of SNEM was promoted to National Director. The basis for his promotion to the National Director position was based on the advances he made in the South Coast region in reducing transmission risk and incidence of malaria, dengue and chagas’ disease through improved surveillance, follow-up, intersectoral collaboration and improved community participation and involvement. He is heavily invested in EcoHealth-style programming, addressing ecosystem and human health through the lens of social justice and community empowerment. As a well-respected health professional with high social capital within the City of Machala, his promotion to National Director is another boost to SNEM’s image and ability to interface with communities, as they are credited in part for his success.
geared far more toward use of insecticides and other chemical agents as primary means for control. This paradigmatic difference may be part of the reason these two programs don’t collaborate freely\(^8\).

A clear divide also exists in the sharing of information between these two entities. The MoH relies on epidemiological information to filter upwards from the primary health care centres for analysis and then strategy planning based on actionable indices. This functions within the MoH system because reporting is required on a daily and weekly basis for particular diseases. The Municipal Health Clinics and hospitals are not required to participate in this reporting, and as a result, the MoH is consistently operating under the assumption of incomplete information and that there are routinely more dengue cases than are officially recognized. Although the most reliable form of actionable data available, information systems within the MoH are criticized for being cumbersome and bureaucratic; they are often held responsible for delays in action taken to prevent dengue epidemics and sub-epidemic transmission due to untimely information relay or incomplete data.

“[Epidemiology] sends us the information that we use to coordinate [a response], to find the reported patients, but many of the patients don’t have a recorded age or sex. Others don’t even have an address. So, like I said at the beginning, that for about 45 to 50% of reported cases we can’t come to their homes to implement mosquito-breeding source elimination and fumigation activities.” – Key informant interview

“Like I said, unfortunately they [the National Institute of Hygiene and the Department of Epidemiology] don’t work in a coordinated manner. Because, since last year, we have been entering and using data and we have noticed that in information from both institutions… that one will have

\(^8\) A document analysis of dengue prevention and control educational and messaging materials geared toward improving public awareness around disease transmission showed a marked difference in perspective. Ministry of Health documents, both distributed by SNEM and by health centres and non-SNEM functionaries, primarily focused on mosquito-breeding source elimination, education, safe medication practices, clear definitions of symptoms and a focus on citizen participation in community health. Documents produced by the Municipal Health Department for the same purposes, focused mainly on allowing access of vector control workers into private homes for the purposes of praying, the use of insecticides within the home and mosquito-breeding source elimination for which one of the options was to apply burnt oil to standing water to kill mosquito larvae.
records for cases that don’t appear for the other, repeated patient registries, a lot of discrepancies.” – Key informant interview

“[Information systems technology] isn’t as respected as it should be. We have departments for everything, except information systems. It’s like we’re still living in the 70’s era, the 70’s when information systems technology was just beginning. And I’m saying this in the era of information technology.” – Key informant interview

Importantly, these information systems rely almost exclusively on quantitative data based on biomedical or technical information. Most decisions are made as quickly as possible using whatever information is reliable and available at the time. Dengue prevention and control activities specifically rely on dengue incidence, suspected and confirmed febrile dengue cases, as well as the House and Breteau entomological indices for predicting the abundance of Aedes vectors. Although there is no similar formal system for the relay of qualitative, experiential information, community meetings are held and vector control and health workers do receive this information and relay it as best they can. The lack of systematization of qualitative information and experiential knowledge of residents and functionaries creates an informational bias in the system that ultimately translates to quantitatively biased evaluation practices, and resulting policies and programs.

Paternalistic messaging and public health programming are the norms and are expected by administrators, functionaries and communities. Paternalism in dengue prevention and control messaging varies from weak to strong; from radio jingles and printed reminders on the back of water bills, to imposing fines and unannounced house inspections as part of entomological surveillance and epidemic control. The dependence on quantitative information facilitates increasingly strong paternalism in policy and programming; this reflects a paradigmatic bias toward technical or biomedical information and carries significant implications for knowledge valuation and decision-making processes.
The current scarcity of both economic and human resources for dengue prevention in Machala has a multiplicative effect; in the absence of capacity for 100% coverage for vector control services, strategic interventions are made on the basis of the severity of risk. Neighbourhoods with high vector indices and/or dengue incidence are singled out for fumigation, brigade inspections, educational days and community meetings with a sense of urgency, under the dengue program belief that timely intervention can contain an outbreak and prevent an epidemic. For some neighbourhoods, high dengue incidence and vector indices are a constant, meaning that they are always at risk for epidemic dengue transmission and they are always red flagged for intervention. Repeated interventions, sometimes in close succession, with the same messaging, and often the same workers interacting with the same residents, that affect no improvement in quantitative risk measures or quality of daily neighbourhood life contribute again to the Quemeimportismo and Social Resentment dynamic. Within such dynamics, neighbourhoods are often seen as unresponsive, ignorant and irresponsible with their health, while government programs that fail to address the underlying determinants of health problems are commonly seen as uncaring, ineffective and out of touch.

“For people here, the more education they complete, the less they learn. Because having more education means you sit very comfortably behind a desk, and you do nothing. You send reports, paper above, paper below, paper over there and everything is for the wastepaper basket. Few of those people will set foot in a community and say, ‘well, let’s work with the community. Let’s go door to door.’ Now, what are we doing? How many people will we over-educate and for what? So that they can sit behind a desk? The people want someone who will work in the community.” – Government functionary focus group

“The Municipality has to be made to understand the word ‘health’. They believe that health is that people are well, that they aren’t sick. They will continue to believe it, but health is more than that. Health is to live more fully, it could be in a house made of cane but that there is peace and tranquility.” – Community focus group participant

9 Housing construction material is considered a good indicator of socio-economic status, which can be correlated with health issues, and in this particular case, with dengue transmission risk.
Dengue is classified as a neglected disease and a disease of poverty because it disproportionately affects people and communities of low socio-economic status and human security indicators. This is clearly shown to be true in Machala as the Pupa per Person Index (PPI) for neighbourhoods with higher socio-economic and human security indicators was under the risk threshold for epidemic dengue transmission, while the PPI for neighbourhoods with lower indicators, at nearly double, was persistently above the epidemic transmission risk threshold (see section 4.3.2 for a more in-depth exploration). Superimposing the dependence on quantitative information and the technical/biomedical bias in decision-making, a targeted pattern of strong paternalism emerges. Paternalism is seldom applied uniformly; indeed by its nature, it is a process for assuming unusual authority over persons or groups of people most in need of assistance and who do not possess a level of autonomy sufficient to advocate on their own behalf [276]. Persistently high indicators of dengue transmission risk, exacerbate the fragile political agency of already-marginalized neighbourhoods within this system.

“We often want to change them, these people’s way of life, but this is not the way. We have to listen to them first, and then seek alternatives with them. Mostly, this isn’t done. I haven’t seen it done.” – Government functionary interview

Restricted economic and human resources affect priority setting and service provision outside of vector control and dengue prevention services. As discussed in previous sections, governments and government administrators are well aware that the problem of patchy provision of sanitary infrastructure underpins many health and social issues. Infrastructure funds and person-hours must be prioritized, as neither is sufficient to cover the entire city. In part, due to the complicated administrative relationship between the Municipal Government, the

Construction cane is considered a poor building material in that it does not form a complete barrier between interior and exterior spaces. The natural cracks and holes in construction cane are desirable in hot, humid climates as they allow air to pass through a home and improve ventilation. It is a risk for arthropod-borne diseases because vectors also pass freely through the structure.
private water utility and the Provincial Government that constantly shifts responsibility for coordinating logistics and installation of sanitary infrastructure, and in part due to priorities for investment in sectors other than health, the dynamic of Centrismo manifests in the midst of the continuing public health crisis of dengue in Machala.

“The Municipal Government has an obligation to 100% water coverage; at least piped water that will preclude the tendency to keep the water containers that create vector-breeding issues. Equally important, now that dengue is no longer simply a seasonal disease, equally important is garbage removal to eliminate the containers that later act as breeding sites. These are the two duties of municipalities.” – Government Administrator Interview

“The infrastructure for the [water] plant is now finished… We are providing water to the city, because we have connected to the pipe network for [the gated community] La Esperanza. The pipe is 600 millimeters, and we have made a 1000 millimeter connection to the pipe network along the Ferroviaria to the 25 de Junio thoroughfare to provide water to another sector where all of the new gated communities are being built: Santa Inéz, Ciudad Verde, Las Brisas, Ciudad del Sol, Porto Verdela, the entire sector in the South.” – Government Administrator Interview

“But along with all of this, you have to wait too. You have to be patient. But we continue, continue to insist. We insist because it is bad, but it is not permanent. So, I think they will revitalize our neighbourhood, and this will help immensely to stop dengue here.” – Neighbourhood President interview

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10 Foreign investment and foreign aid has resulted in the completion of a new, fully operational water treatment plant for the City of Machala. This plant produces high quality water intended for human consumption, that if distributed through sanitary water network infrastructure could be consumed at the access point in the homes of the recipients. The pipes for this water plant cross whole sections of the city who do not have access to the municipal water system, nor have access to potable water in their homes, only to provide water to newly built gated communities funded by private investment, developers and where socioeconomic indicators are high. The rationale for this water distribution strategy is that the neighbourhoods between the plant and the new cities that are in need of potable water, do not have the water-pipe infrastructure to ensure the quality of the water once it reaches the home. Because the water plant is associated with the Municipal Government, but the pipe infrastructure is under the authority of the private water utility, they did not pursue that avenue. In the case of the new gated communities, the water pipe infrastructure was paid for by the private investors and developers, is high quality and is ready to receive the water.
4.1.1.5 Private Sector

The main private sector actor in the community-based dengue prevention and control social network is Triple Oro, the private water utility. The utility was contracted by a previous Municipal Government to administer public works as they pertain to water provision and sanitary sewerage.

As a private company, it exists completely outside the authority hierarchy of the Municipal Government and the Ministry system and is often the scapegoat for both of these entities with respect to high dengue incidence, high vector densities and continued lack of infrastructure provision. The circular shirking of responsibility often begins with residents denouncing the lack of sanitary infrastructure to the Ministry of Health, either through primary care centres or through SNEM functionaries, the MoH then indicates the source of frustration is the failure on the part of the Municipal Government to fulfill their duties in providing conditions under which dengue will not flourish, the Municipal Government then indicates that the responsibility to provide better conditions falls on the administration of Triple Oro. The circle of blame continues when Triple Oro indicates that they cannot act alone; there must be coordination with the Municipality to provide paved streets and sidewalks to facilitate the installation of storm sewers, provide land-fill for depressed areas to facilitate the installation of piped water and sanitary sewers and that the Municipality must lay these foundations before any work can begin on the installation process.

“This sector of the city does not have piped water or sewers. But it is also lies in a depression. So, we asked the Municipality to give us their plans indicating the level of fill, the area they will cover and where they will make sidewalks and curbs. I can’t [install infrastructure] in mid-air… We still have not received the plans even though we asked for them, and each of us has a role in this, each is responsible for their own thing. So, we would like to coordinate more with their work, and not just that they demand, ‘Come today and help us, lay the pipes here so that I can finish the street.’ There are many places that we could service with some planning, but right now it’s not happening. Without planning we can’t make any progress.” – Key informant interview
“We oversee this well and we treat the water with chlorination. This is a deep extraction well, we use a pump and suction system to extract the water before we treat it, chlorinate it and distribute it. But there is the problem. The distribution network immediately around the well is good, made of stone. But then come the little tubes that I was telling you about. These tubes are not technically adequate for the delivery of [potable] water. [It is infrastructure] that is old or anti-technical, because people who are desperate for water will find a water delivery line, make a hole and insert their own tubing that is made of materials that they shouldn’t use. [Those holes] allow dirt and who knows what else to enter the system.” – Key informant interview

Triple Oro was contracted for 50 years in 2004 to administer the water utility for Machala. In a city with a long history of insufficient basic infrastructure, this was, and continues to be, a controversial arrangement filled with tensions, both political and within the user/provider relationship. Although the private utility does provide water services insofar as existing infrastructure allows and is constantly working to improve infrastructure where they can, there is a political animosity toward them. Graffiti is often seen in public spaces denouncing Triple Oro’s inaction to improve water security in Machala, particularly for vulnerable neighbourhoods; they are unaffectionately nicknamed “Triple Robo”, or triple robbery in reference to water prices, uneven distribution of services and poor water quality.\(^{11}\)

“[Machala] has a history of neglect and when you suddenly try to do something, to improve it like it has fallen to us to do, it’s very difficult… you have to do it one stretch at a time. There are many people who understand that and who thank us. People who did not have services, but who have them now. But there are other people who absurdly are not in agreement. I mean, this is a 50-year project and we are only in year 6 or 7. I mean, there is a lot left to do.” – Key informant interview

\(^{11}\) Graffiti is common in Machala, particularly in peri-urban neighbourhoods where water security is low and infrastructure insufficient or absent. “Triple Robo” is a common graffiti seen in different sectors of the city. At the southern entrance to the city, at one of the busiest intersections of one of the busiest thoroughfares in Machala there is a graffiti that reads “Hasta cuando Sr. Alcalde. Fuera Triple Oro!”, which is translated as “Until when Mr. Mayor? Get rid of Triple Oro!”. This underlines the consciousness of the shared responsibility of the Municipal Government and Triple Oro to fulfill their mandate to provide infrastructure and services, and the perceived inaction on both parts to make it happen. This also points to the anger and frustration felt by many residents that contributes to Social Resentment around water security and community health.
Triple Oro’s role in both the social and environmental determinants of dengue transmission risk is widely accepted, even by the water utility itself. They see themselves as an important contributor to the community-based dengue prevention and control, rather than the root of the problem. Indeed, Triple Oro works with communities to improve infrastructure where possible and to aid in community empowerment efforts. Serendipitously, a close relationship and history of collaboration exists between the utility and one of the neighbourhoods involved in the EBS-Ecuador project where support was given to improve a daycare/preschool centre and to provide access to safe water. Triple Oro routinely supports SNEM vector control efforts by providing vehicles and drivers to transport brigades to neighbourhoods at risk and asking for support. As well, public information campaigns regarding dengue prevention, symptoms and safe medication practices are regularly printed on the backs of water bills.

“We customarily work with SNEM to support the aspect of fumigation. It began 3 or 4 years ago… and we do it every year; in winter, we fumigate. We provide logistic support to SNEM, we provide vehicles and the rest [of what’s needed with respect to transport]. We have also collaborated with medical brigades. We have helped the Ministry of Health and their health centres with medical brigades and vaccination campaigns. We help them, and then we return to our work. But our work is sewers, right?” – Key informant interview

In 2012, by order from President Correa and after a long and bitter legal battle with the Municipal Government of Machala, Triple Oro was forcibly stripped of its contract and administration duties. The Triple Oro offices were occupied by the military and the National Government assumed interim control of the utility through force [277, 278]. There was a sentiment of relief, and even jubilation, in Machala at the liberation of water security from private industry, that control would be returned to the people through democratic channels. By late 2012, another private company stepped in to fill Triple Oro’s role and no significant changes have taken place in planning or service provision schemes.

Media outlets are the second prominent private sector actors in the social network. Their connections to other stakeholders are more transient and
nebulous than others, their involvement and influence are harder to evaluate. There are three newspapers, several radio stations and two local television channels in Machala, all of which are active in reporting on health issues through contact with government actors, government functionaries, local governments, residents, researchers and private sector actors.

“Another thing that they must do is broadcast more propaganda through television and radio. Fill them with [health] messaging, send the message directly [to the people].” - Government functionary focus group participant

“They have ample access to television channels, right? They should utilize that to create education programs, I mean, people who have experience and training should speak on particular diseases that are preventable, on prevention measures and how to avoid getting dengue and malaria.” – Government functionary focus group participant

Media outlets provide additional means for public health education campaigns for dengue prevention and control through advertising and public service announcements. More than that, press coverage of outbreaks and epidemics, satisfaction or lack thereof with public health programming, interviews exploring innovative approaches or collaborations to improve dengue prevention and control, and opinion pieces examining dengue programs, policies and determinants all influence the opinions and engagement of an incalculable number of stakeholders in the social network [279, 280]. Residents rely on television, radio and newspapers to stay informed about prevention measures, to form opinions regarding the state of affairs and organize actions (or not) around the issues.

“Of course we get stay informed through television; this thing here, that disease there, you have to stay on top of things. Well, but it’s not as if all of us listen to the news to get all of our information. I am one of these people who buys the newspaper, I have it in my house and sit down and read the whole thing. And sometimes, there are stories in there about my neighbourhood, what’s happening here, who got robbed…” – Neighbourhood President focus group participant

Media outlets are also seen as viable allies in the struggle to improve water security and political visibility of marginalized neighbourhoods and communities.
Exerting media pressure is recognized as an effective measure to influence the policy process and public health program implementation.

“Reporters, in reality, have a wide influence through information. Communities should also consider this opportunity to relay information and perspectives to reporters so they can share information with other communities.” – Key informant interview

4.1.1.6 Researchers

This stakeholder group is by far the smallest of all defined stakeholder groups within the social network. Interestingly, pure academic researchers are not normally included in dengue prevention and control activities; as such, the EBS-Ecuador project provides a unique opportunity for researchers to engage in a relatively non-academic system and for the dengue prevention and control social network to access research support for design, implementation, evaluation and policy-making processes.

Researchers are viewed within the social network as:

1) outside experts who provide an essential and objective point of view regarding the challenges, strengths and opportunities for improved community-based and participatory dengue prevention and control in Machala

2) the purveyors of much needed economic and human resources to support existing and changing public health programs

3) intermediaries between dissonant stakeholder groups, as well as facilitators of intersectoral collaboration and construction of intersectoral spaces; particularly with reference to politically or socially marginalized voices

4) Gatekeepers of other-language and current scientific literature and best practices, allies who enable robust, publishable results reporting in a culture oriented toward implementation rather than academic documentation
5) Relatively unbiased bodies available and able to improve evaluation and follow-up activities, and create or increase local capacity to sustain these improved activities

A distinction must be made regarding this stakeholder group in this particular case. Pure researchers, for the purposes of this work, are considered those who do not have professional affiliations with any governmental entity directly responsible for dengue prevention and control activities, programs or policies in Machala or the province of El Oro. There are, however, researchers that are integral to the EBS-Ecuador project research team that hold administrator positions within the Ministry of Health and SNEM\textsuperscript{12}. This carries implications for both the amenability of important government stakeholders to work alongside researchers in the research-to-policy process, as well as for strengthening praxis-oriented research through the involvement of decision-makers from the formative stages of participatory work. Pure researchers, researcher-administrators and researcher-practitioners are all included in this stakeholder group, acknowledging that there is some overlap between this stakeholder group and government.

Researchers bring a focus on macro-determinants of health and of dengue transmission risk. This amplified vision of dengue and its determination in Machala, however, may also carry implications for masked paternalism and “othering” through the application of theories and practices conceived within cultural, knowledge and social systems that are, by their nature, oppressive and that marginalize populations affected by dengue. In this social network, all of the pure researchers are visitors to the Machalan context, either as international

\textsuperscript{12} Specifically, the National Director of SNEM and the Coordinator for the Heath Area of Machala under the Ministry of Health designed and executed the two pilot projects upon which the current EBS-Ecuador project is based, as theses for Masters of Public Health with and Ecosystems Focus degrees. The masters program for which they wrote these theses was an output of a joint CIDA-funded endeavour to create and increase capacity for EcoHealth-style research in Ecuador through post-graduate training programs. The EBS-Ecuador project has three principal investigators, one of whom is the National Director of SNEM, and the other two were co-principal investigators on the CIDA-funded capacity building project.
partners or national partners hailing from a different political, social, cultural and environmental context. The strength of this particular group of researchers is that the more theoretical and arms-length researchers are balanced with researchers that are deeply grounded within the Machalan context, particularly in infectious and vector-borne disease prevention and control public health programs.

“Dengue can be a great teacher. It could be a teacher of understanding and consciousness of how not to engage in the victim-blaming process. I mean, the family is accused of not understanding that they have to remove a tire [from their property] and nobody says anything about the industry. Not even the Municipality will provide help to address that tire, or act on the overproduction of tires in our society. I think that dengue, for the relative clarity of its social determination, that dengue could be a great teacher and it should be taken as an initial, formative experience to create a more complete consciousness around health and sanitation. There should not be, as is our way of thinking, such a strong focus on dengue prevention and control at the household level without also a focus on dengue control at the level of Municipal policy, at the level of agroindustry, pesticide use, monoculture and agrochemical dispersion systems.” – Key informant interview

“Well, researchers have to perform more than just research; they should try to coordinate with the authorities more to open their research in the field so that people will see change.” – Key informant interview

Evaluation of projects and programs is weak within governmental systems in Machala. Again, this is often attributed to the human and economic resources shortage that permeates nearly all governmental entities. Without the expectation of robust evaluation procedures or best practices, there is little bureaucratic incentive to invest scarce resources to developing these capacities. This serves to exacerbate the qualitative data vacuum and informational bias discussed whereby administrators and practitioners rely on the quantitative data that is rendered through epidemiological and entomological information systems. Researchers provide additional resources and expertise in the area of evaluation, results communication, policy recommendations and re-initiation of the research cycle through follow-up strategies. Researchers also ought to bring strong advocacy for equitable knowledge valuation schemes for these processes to
ensure the inclusion of marginalized voices and experiences within the research-to-policy process.

“Despite [efforts to produce useful research], the research that is done consists of pilot projects or something small. The get their results but there is no evaluation and follow-up that would transform practice.” – Key informant interview

“[Researchers] would be important here because they have experience, because, well, they will help with evaluation, they will help to uncover results, help with analysis and everything that we don’t have the capacities to do.” – Government Administrator interview

“To come to the community and identify risks, to reduce the risk associated with [dengue vector] presence; the risks that persist despite the implementation of health measures and health policy. And maybe too, to identify what areas the current system has not yet considered as priorities, that require sincere effort and consideration, and that ought to be addressed as priorities, urgently and emergently.” – Government administrator interview

Despite the relative rarity of pure researchers within the social network, research, campaigns, specifically targeted health projects, and services innovation pilots are routinely posed by governmental and non-governmental institutions alike. There is an overwhelming concern that these short-term projects do not affect change through their results, nor are the results normally communicated to participants and other interested stakeholder groups. Part of the enthusiasm for pure researchers within this network is the hope that some of these processes, evaluation, results sharing and the application of results, will change and that equitable participation will be emphasized.

“Like I always say, every researcher should go to the field to see for themselves, they shouldn’t stay behind a desk and wait for everything to come to them without understanding the reality of the situation. They have to be there to understand the problems in some of these neighbourhoods.” – Government functionary interview

“Lots of people are open to support these projects. But, they do their work, get their results and that’s it and ciao, and nothing will come of it just like we thought. But I think that these people who are doing these research projects, when they get their results, they ought to be applied. They should apply their results [to affect change] and bring them back to the
community. I mean, share their results and in sharing them they will incentivize [the participants] by saying, ‘you did this, you participated in this’. Let people know that they were important in the project and because of that the results will be applied in different places.” – Government functionary interview

Researchers come to this social network, just as the other stakeholders do, with their own narrative; that includes priorities, agendas, timelines and objectives. Participatory and community-based research is designed to align researcher priorities with the priorities of local stakeholders, communities and residents in particular, however, as researchers are beholden to funders, academic outputs and short timelines, equity of process and applicability of results may give way to research agendas and more abstract, theoretical results.

“What we are asking for is that [researchers] also help us. That they work with us so that [our concerns] will reach the authorities and so that they will take us into consideration. Otherwise, we will just continue to make requests, fill out forms and write official letters, but this is useless, they don’t take it seriously.” – Local government interview

“In the specific case of dengue, I would say we need to work diligently on overcoming disingenuous epidemiology and then introducing critical epidemiology. Secondly, we have to change the reductionist vector and parasite ecology to a critical ecology.” – Key informant interview

4.1.2 Cultural dynamics and the power of perception

The previous section discussed the six stakeholder groups involved in and affected by participatory dengue prevention and control in Machala: community, local government, government functionary, government administrator, researcher and private sector actors. This ethnographically framed stakeholder analysis offers a contextualized picture of the people and groups of people who interact with one another to address this complex health issue from their various experiences and positions within the social, cultural and political fabric. The following sections provide an ethnographic analysis of the deeper dynamics that influence the way that these people interact with one another, and indeed, with the health issue of dengue, with political and institutional structures, and with the processes involved with participatory prevention and control programs.
4.1.2.1 Dengue as a priority among many: framing the issues

Dengue is only one health concern among many in Machala, and it is not necessarily at the top of the list. Just as weak infrastructure and restrictive budgets are determinants of dengue transmission risk, so they are for many other diseases: tuberculosis, diarrheal diseases, childhood malnutrition, pneumonia, chronic upper respiratory tract infections, malaria, influenza, measles, HIV/AIDS and other sexually transmitted infections are all common, pressing and persistent concerns. Chronic disease and occupational health are also major concerns: hypertension, diabetes, cancers of all kinds, agrochemical toxicity, and worker injury to name a few. Pervasive social issues in a rapidly growing population also result in increasing burdens on the health system and on communities themselves: gang and domestic violence, sexual assault, sexual exploitation and abuse of minors, homophobia, and precocious pregnancy in young adolescents.

For those working to improve dengue prevention and control programming, it is the top priority. For those who are removed from the vertical program, and for those who recently have not experienced a severe illness or death from dengue in their inner social circles, the urgency is lost amidst this sea of other concerns. Dengue is a common disease in Machala, and even with recent advances and successes in reducing dengue risk, it is still considered to be commonplace and again, urgency is lost. Furthermore, there are many people in Machala who live very near or at the poverty line, and commonly in these cases, top priority is earning their daily keep often at jobs with low wages, long hours and poor conditions.

Considering dengue as one of a myriad of health issues embedded in a complex web of social, cultural and political determinants is imperative when considering the following social and cultural dynamics emerging from the ethnography, interview and focus group data. The need for perspective is illustrated well through the issue of water security, the lack of sanitary infrastructure and
dengue. Dengue researchers and practitioners consider water security through the lens of dengue risk, in order to prevent the presence of mosquito-breeding sources, the presence of the mosquito and finally, dengue transmission, access to safe water should be provided. Other health practitioners and perhaps governmental entities not specifically dedicated to dengue might view water security as a basic sanitary measure that would prevent many diseases and health issues. Communities would view the issue of water security as a human rights issue, as a basic requirement for human security and as an issue of human dignity.

That is not to say that these views, perceptions and orientations do not cross the boundaries of stakeholder groups, indeed they do. Many researchers, administrators, practitioners and the like are motivated precisely because dengue opens a window on an unjust system of resource allocation and political will. Many community members, as well, engage in victim blaming and are angered by the perceived apathy and inaction of their neighbours and friends in the face of such an imminent health threat, regardless of their circumstances. The following discussion of social and cultural dynamics that influence dengue transmission risk distribution as well as community-based and participatory dengue prevention and control in Machala are offered as an exploration of not-readily-apparent influences, and they should be considered as subjective contributions to an ever-evolving exploration and evaluation process rather than objective, static categorizations of ways of living, being, knowing and working.

4.1.2.2 Paternalism and equitable participation

Current knowledge valuation schemes within the hierarchy of decision-makers essentially preclude the exploration of experiential knowledge, story and qualitative accounts of social and cultural determinants of dengue transmission risk in order to inform program design and policy. Participatory action research, EcoHealth and the EBS paradigm all advocate for community involvement from the beginning of the research process to subvert prejudicial dynamics like exclusive knowledge valuation ideals. In this sense, it is important to include
members of the community in each phase of the process, but also to include their ways of knowing, understanding and expressing themselves.

“The moment we involve the community every step of the way, they will support us more than they do now.” – Key informant interview

“Often we call on the communities only to inform them of what we will do, but not to share the results.” – Key Informant Interview (GA)

Equitable participation is also important outside the realm of research. For public health policies and programs to be effective in addressing community health issues, decision-makers must first understand the problems they are trying to address. Dialogue, equitable interchange of ideas, is required to cultivate meaningful understanding of contextual nuances that may significantly affect design, implementation and evaluation of preventive health strategies [281, 282]. Paternalism in messaging, programs, policy and the research process directly counteract efforts toward equitable community participation and serves to disempower communities through marginalization of their voice, experience, knowledge and perspectives.

“This is the difficulty, then. I mean, we can’t reach our goals because we are at the bottom and the authorities are at the top.” – Community resident focus group

“No matter, we will go on getting paid. However, the community will be harmed. I mean, I only speak from my own point of view, I have seen it happen in other places. However, I am optimistic that here the opposite will happen, that we will succeed in this sense. That is all I can say.” – Key informant interview

Paternalism itself can thus be seen as a social determinant of health with strong political overtones. Disempowered and marginalized communities and groups of people are more vulnerable to disease and illness; physical, social and political risk factors contribute to an intensifying downward spiral of powerlessness, poor health and paternalism (Figure 7) [283]. Marginalized communities with little political agency and persistent health issues are targeted as “most in need of
intervention” by paternalistic health programming, messaging and research; the paternalistic interventions reinforce both actual and perceived powerlessness within the community, in turn placing them at higher risk for disease and continued paternalistic intervention.

The strong paternalism present in current dengue prevention and control strategies in Ecuador may be, in this respect, putting the most affected communities at greater risk for persistent and intensified dengue transmission and simultaneously, at greater risk for other diseases, health and human security issues. The current work on improving community-based and participatory dengue prevention and control programs is a step away from conventional activity, however, there ought to be careful consideration to address paternalism as it manifests over the entire arc of the research-to-policy process, with particular reference to data collection, results sharing and evaluation. Without acknowledging and working to reduce pervasive paternalism, resulting policy and program implementation may continue to disempower communities, regardless of innovation.

Figure 7 – a) Paternalism and powerlessness as determinants of health (adapted from Wallerstein 1992) and b) the paternalism-powerlessness-disease cycle
4.1.2.3 Quemeimportismo and social resentment

Quemeimportismo and its counterpart social resentment both contribute to and are reinforced by information bias and paternalism in public health programs. Paternalistic views of communities at risk for dengue transmission allow the assumption of the existence of some impediment to neighbourhoods acting on their own behalf to reduce this risk; as discussed in previous sections, Quemeimportismo is often a label applied to ‘others’ in large part from the top-down, but residents will often label one another as well. There is a pervasive argument within government stakeholder groups that this assumed impediment comes from within the community, most often it is attributed to a lack of education combined with social apathy or social irresponsibility. Dengue prevention and control discourse in Machala is shot through with disempowering rhetoric because of paternalistic framing, the basis of which is that if communities weren’t dysfunctional, they would not be sick.

“We have a culture of accumulation. That’s the truth... Because there are people who collect even lids and leave them in their patio. I mean, lids, bottles, pots; well, that’s what they do. So, we have to work culturally, I think, more often. This has been the most challenging part and will continue to be the most difficult part. You see, the other thing is that people, like me as citizen, say, ‘what can I contribute to change the problem of dengue as it is?’ I mean, not so much for dengue, but in the reduction of mosquito breeding sites that we know produce vectors, in clean water, et cetera. We have hardly made any progress in this area, because the people still don’t bear the responsibility as citizens to care for the health of others and of children.” – Key Informant interview

At a deeper level, Quemeimportismo carries the connotation of an eroded social structure at the community level that penetrates to family structure and caring for the health of one’s family. Knowledge valuation bias toward the technical and

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13 The assumption that dengue transmission continues to be a public health issue of major concern because of a lack of knowledge around dengue, dengue transmission dynamics and mosquito vector life-cycles was addressed through the household survey of the EBS-Ecuador project. The results of the survey showed that of the 2000 respondents, 98.8% of them knew about dengue and 87% of them correctly understood dengue transmission dynamics including vector breeding behaviours. Despite this, among other, evidence to the contrary, the assumption of lack of education within the community persists among government administrators and functionaries.
biomedical feeds into this conception of reckless indifference; education campaigns emphasize the danger that a single home with containers positive for the presence of Aedes mosquito larvae and pupae may pose to the health of the entire neighbourhood. Indeed, mosquitoes are mobile vectors of disease and easily occupy a feeding territory of a 100m or greater radius from where they emerge, vector biology and epidemiology play a significant role in perpetuating overt and cryptic victim blaming. Quemeimportismo then becomes an institutionally sanctioned vehicle for targeting problematic individuals rather than problematic determinants of dengue transmission risk.

“This [problem of dengue], we say, is not because they don’t know, but it is the Quemeimportismo of the people who say, ‘Ah! Those little bugs don't do anything’. And we are seeing this happen” – Community Resident Focus Group

“Of course, here you have to push people a little because this is one of the idiosyncrasies of our way of living, right? When there are no problems, we don't take any precautions.” – Neighbourhood President interview

Social resentment emerges almost as a counter-balance or a pushback against paternalism, exclusionary knowledge valuation and victim blaming in messaging and services. Community-based, participatory or community-placed interventions are of particular importance in the development and reinforcement of this dynamic. Communities are often asked to participate in health initiatives, projects or programs after the conception and design stages, essentially removing the opportunity for equitable participation, dialogue and autonomous determination of community roles and priorities within the endeavour. Stories, lived experiences and a deeper contextual understanding are offered at the researcher/practitioner/functionary/resident interface, but these kinds of knowledge rarely inform decision-making processes; in part because they were excluded from the conception and design process, and in part because they are considered less rigorous and current information systems do not accommodate them.
The relative absence of inclusive evaluation practices with regards to dengue prevention and control programs in Machala is of particular concern and importance for social resentment. The facilitated window for community participation allows for input during the implementation phase for most initiatives, often with a promise to take community knowledge and experience into account during evaluation as a means of influencing future iterations of the same initiative. Unfortunately, evaluation and follow-up is described as weak and sporadic if not absent from the majority of public health programs, pilots and special initiatives. Information, knowledge, results and benefit are cultivated within the community and exported to other regions, entities and stakeholder groups; this exploitative process is cyclic, thus, communities and residents receive disempowering process or experiential messaging as well as instructional public health messaging.

““We are waking up, we see how institutions, owners of institutions, of foundations ride in extended-cab vehicles, go about their lives with ample financial comfort, that they exploit these projects. But nothing comes to the people. Nothing comes to the people, so the people are disillusioned, ‘You used me. Why do you use me?’ And another proposal comes, in a different form, but the same intent. With a different form, they come asking for all of this, ‘Now, yes. This time it will work, we are going to solve these problems here, we are going to solve these problems for your neighbours. This time it will be different.’” – Neighbourhood President Interview

“It’s a burden that we are there again saying the same thing, and we can’t assure sustainability, not just economically speaking either. But if [we] contribute by going and giving talks, to follow-up with them, to undertake evaluations with them; these are the kinds of things that the community will do with the right motivation, [partnership]. We [as government entities] also have a responsibility to the right motivation… by that I mean, there must be continuous dialogue.” – Key informant interview
Without the creation of and support for inclusive evaluation-implementation cycles that facilitate equitable participation for all stakeholder groups, destructive social and cultural dynamics will persist, as will social, environmental and cultural determinants of dengue risk and dengue transmission. As evidenced by recurrent issues and deficiencies in subsequent iterations of public health interventions, it becomes apparent to communities their contributions have been excluded from the evaluation process, or if they have not been excluded, there were not considered to the effect that impact is apparent in programming or service delivery. The absence of change in services is a message in and of itself as to the futility of meaningful community participation; this reinforces the dynamic of social resentment and discourages collaboration, which in turn reinforces the perception of Quemeimportismo.

“They only care in the moment [that we are there] and then they forget like they were never interested. It’s like health [for them] is the responsibility of an institution that should do everything… come and clean up, change things… that the institution should do it and not them.” – Key informant interview

“They only care in the moment [that we are there] and then they forget like they were never interested. It’s like health [for them] is the responsibility of an institution that should do everything… come and clean up, change things… that the institution should do it and not them.” – Key informant interview

“Clearly, for example, I’m telling you that here in this neighbourhood, I don’t know. I say that because all of the effort that we have put into this project. Very few people are collaborating, right? I mean, they don’t collaborate very much. I mean, we are people… how can I explain… it’s that we only want to be served and not to serve.” – Community Resident Focus Group

4.1.2.4 Nepotism, centrism and social justice
As discussed in previous sections, corruption is an expected element of political process in Machala, and more widely in the Province of El Oro and Ecuador. In Machala this manifests as a concentration of wealth in the city centre, around industry and in newly developing districts in the city. There is also an expectation that resources are distributed based on personal connections with government officials, that well-connected neighbourhoods receive attention while those “ordinary” neighbourhoods do not.
“I mean, all of the resources go to the city centre. Not even a bit for the peri-urban and neighbourhoods, mostly to the city centre and to their friends. Well, they are political game players, so they pay no attention to us because we have no direct deal with them. Despite the fact that we have tried through official written channels, speaking with the Municipal Council and their leader the Mayor, they haven’t given us any consideration. So the political aspect of this is still in process, the coordination of it, but this year in 2011, the laws are changing. The assembly has approved it, they are going to implement a sort of obligation to coordinate with county councils, with the parish unions and other local governments. So, thanks to this law that they have enacted this year in April, I believe that in the coming year, incidentally, they will have to coordinate with us directly. At least we hope so, because they have introduced the law. I mean, before there was no law for citizen participation.” –Key Informant Interview (GL)

“Here the people are happy because I am President. When you do things that leave their mark, and make people follow you it is the traditional sort of power. If you’re not with them, they’ll hound you. I have a close relationship with the Mayor, I have done a lot of work a lot with the Mayor and I have that image. He’s my friend.” –Neighbourhood President interview

These socio-political manifestations of corruption and deprioritization of human security and well-being for residents as a whole contribute to the dynamics of social resentment and perceived futility of equitable participation both as an investment and an ideal.

4.1.2.5 Recognition of voice & right to influence one’s own health

Community participation is important for the acceptability, sustainability and effectiveness of dengue prevention and control programs [284]. Participatory and community based action research has been gaining in popularity in many disciplines, public and community health in particular. Inclusion of participatory principles in the EcoHealth, Eco-Bio-Social and Ecosystems approach to Human Health frameworks speaks to the investment in the ideal for dengue researchers, administrators and practitioners in Machala.

The vertical nature of health systems and governmental programs in Ecuador, and Machala, serves to exacerbate this. Dengue prevention and control falls under the purview of a vertically funded and administrated program whose
purpose is to reduce the incidence of vector-borne disease; this ultimate end serves as a political frame for all programs, strategies and initiatives undertaken by the program. In this sense, community participation is seen as an important ingredient in the recipe needed to achieve lower dengue incidence. Community participation as a means to achieving an end, regardless of how positive that “end” is, estranges the core founding principle of community-based research: equity.

“The same political story repeats itself within institutions. Here we are, at the point of evaluation. I think that now they better evaluate themselves, including the authorities, how they invest [their resources] everywhere; I don’t think it should be in their offices. Instead, the people need to work with the authorities so that these projects benefit the community. Because these people say, ‘When are you going to solve my problems?’, not ‘How will you help me solve my own problem?’ To evaluate the efficacy of a project, if you look in the offices you are screwed. If you look at papers, they will keep everything. And they will go and put forward the best photos, and the best statistics and the best indicators. But this is absolutely useless. Authorities ought to give this consideration to the [intended] beneficiaries of the projects. I say this because I have lived in the hopes of those projects, all of the hopes, and later when this runs out, and this, and this, it all disappears. They are… For me they are terrible, terrible acts of corruption. Because, how could they go and use the people and later keep all the money?” – Neighbourhood President Interview

The discussion of the cultural and social dynamics of paternalism, Quemeimportismo, social resentment and corruption describes a structurally violent system, under which communities most affected by dengue are marginalized and frustrated. Biomedically-centered conceptions of health and bias toward technological information serve to undermine equitable community participation, even with the best and noblest of intentions. Equitable community participation in dengue projects and programs ought not to be considered a methodological item to be incorporated or an ad-hoc effort to improve community buy-in. Community-based participatory dengue prevention and control programs ought to be situated within the frame of health as a human right, incorporating freedom from structural violence and the right to participate autonomously in
one’s own health. Equitable participation is community health practice, praxis and innovation with emancipatory design.

“Well, I know that the community has a natural organization. But we ought to include these organized communities as an entity within the state, in this case with us as part of the Ministry of Health, so that the organizations have direction. That is, we must discuss with them, ‘What are the most important issues in the minds of this community?’ It’s a shift in the epidemiological question… We must organize ourselves and travel to the places where we must to understand the pain or the needs or the health risks of that community.” – Government administrator interview

Equitable community participation at every stage of the research-to-policy process, and beyond that in recurrent implementation-evaluation-design cycles carries heavy implications for the structure of systems, timelines, budgets and expectations. In the example of participatory dengue prevention and control in Machala, this might imply the creation of new information systems, re-training and consciousness building within government entities, opening budgets and creating inclusive intersectoral spaces where only bitter conflict exists. These changes must occur on all levels, from the local to the global, and would require significant investment of political-will, time, economic resources, human resources and reflection, on the parts of all stakeholders involved.

4.2 Social network analysis
The first sections of this chapter have used ethnography and stakeholder analysis to lay the groundwork for a more technical interpretation of the connections between stakeholders and stakeholder groups involved with and affected by participatory dengue prevention and control in Machala. The context established in section 4.1 is both a survey of the actors and a multi-dimensional illustration of some of the nuances of their interactions with one another and with present social, political and economic structures. The following social network map and social network analysis are situated within that local context and should be interpreted as such. Importantly, the description of this social network only pertains to the network as it applies to dengue prevention and control (both
participatory and conventional) in Machala; it does not presume to describe the network in general terms nor does it presume to describe Machala as a whole. This social network map and analysis is presented with the full and explicit understanding that it is a description of only a specific portion of a much larger, deeply nuanced and diverse social network: Machala as a social, cultural, political, ecological, and biological phenomenon with its own intricate narrative, history and identity.

Specifically, I present results here that facilitate a more articulate conception of the complexities of the social network as it pertains to participatory dengue prevention and control in Machala by providing a schematic around which the context and connections between stakeholders and stakeholder groups can be more clearly visualized.

4.2.1 Social network map
The social network as it pertains to stakeholders and stakeholder groups identified through ethnographic observation and stakeholder analysis is complex, involving parallel political and service delivery systems that are linked but that often do not share information, resources or responsibility freely. With a total of 35 nodes and 188 edges connecting six stakeholder groups involved in, or affected by, community-based participatory dengue prevention and control efforts in Machala, it is important to form a basic understanding of power, communication and resource-sharing dynamics to lay a foundation for inclusive, participatory evaluation processes designed to improve service delivery and program impact (Figures 8 & 9).

It should be noted at the outset of this section that media outlets were not included in the social network analysis; this includes television, radio and print. Although the media do play an important role in broadcast messaging, a point of access for community voice, an instrument of social and political pressure and providing a forum for public debate (as reviewed in section 4.1.1.5), the rationale for excluding them from the debate evolved from ethnographic observation and
focus group/interview data that suggested the relationships the media possess within the stakeholder network were ubiquitous, meaning all stakeholder groups could access them. For the purposes of quantitative analysis, the results would be obvious. That is not to say, however, that there aren’t nuances of relationships with the media depending on stakeholder group; more powerful actors within government hierarchy may have more control over how the media reports their information than less powerful actors. This is an interesting, and for the purposes of this thesis, relatively unexplored dynamic that may influence how stakeholder voices are perceived in the public sphere.

Figure 8 – Schematic of community-based dengue prevention and control social network in Machala
The overall density of the social network as it pertains to community-based and participatory dengue prevention and control in Machala (heretofore referred to as the Machala Network), is 0.158, or only 15.8% of possible connections between actors in the network are occupied by an extant relationship. The maximum degree possessed by an actor in the network is the Municipal Government of Machala with whom 25 other actors are connected (Figure 9, Table 8); even the most connected actor still falls 10 connections short of reaching the entire network. This relatively low density can be attributed to vertical government structures split by disciplinary silos, a distinct divide of political responsibility, service provision and information sharing between the Ministry System and the Municipal Government, as well as the concentration of community collaboration within hierarchically low-level stakeholder groups. High network density implies ease of coordination of members within the network [285], and understanding that the Machala Network is divided by political and disciplinary boundaries, this may be an indicator of, as well as contributing factor to, difficulty in establishing and maintaining robust intersectoral spaces and collaboration.
Figur 9 – Betweenness centrality map of the Machala Network

Betweenness centrality measures the number of times an actor appears on the shortest path between two other actors and is often used as an indicator of influence on communication dynamics. As centrality is a measure of “visibility” within the social network, betweenness could indicate presence and influence as it pertains to information sharing and knowledge valuation. It is important to recall that centrality does not necessarily translate to popularity or likeability. Rather, it ought to be likened to notoriety; an unpopular actor with high betweenness centrality could be described as “notorious”, while a popular actor with the same measure described as “noted”.
The Municipal Government of Machala has the highest betweenness centrality of the network, however, its description from within the social network is far more toward the “notorious” end of the scale. The Municipal Government connects paths between actors for information, services and planning; these connections, however, do not always facilitate progress or coordination. Two examples of such interactions are:

1) neighbourhood presidents advocating for improved basic infrastructure in their communities, and trying in vain to have an audience with the Deputy Mayor’s office, or getting an audience to no effect. In this case the Municipal Government would be a link between neighbourhood presidents and Triple Oro, the Municipal Department of Public Works, the Provincial Prefecture and/or the Provincial Council. This connection could equally be considered in reverse; Triple Oro’s frustrated requests for planning coordination with the Municipality in an attempt to respond to communities.

2) In an attempt to reduce mosquito breeding sources and water-borne disease incidence in neighbourhoods, Community Health Inspectors report on illegal urban pig pens and vacant lots used as dump sites to the Municipal Health Department through the Municipal Health Commissioner’s office. The function of this office is to issue fines and enforce Municipal health by-laws under the authority of the Municipal Government. Interviewed health inspectors and government functionaries report that these attempts to coordinate with the Municipality go unanswered or remain “pending” indefinitely, in essence, disrupting health governance and risk prevention strategies. Similar interactions occur between the Municipality and SNEM brigades, brigade chiefs and administrators, Ministry of Heath administrators, Neighbourhood Presidents, residents, community groups and schools.

That is not to say that all interactions within the network are impeded by the Municipal Government; as described in previous sections they actively support
community clean-up efforts, improve infrastructure as they can and seasonally contribute to dengue prevention and control activities. When considering the informational “visibility” or influence of the Municipal Government through its betweenness centrality measure, contextual understanding of disjointed information systems is crucial, especially as it relates to reportable infectious diseases and dengue. The Municipal health system is a stand-alone system that is not beholden to reporting policies of the Ministry of Health, nor does it readily share information on dengue risk, incidence or confirmed cases with the official MoH registry. SNEM, a body included in the Ministry of Health, is established within the Machala Network as the authority and principal government actor for dengue prevention and control; official statistics for dengue risk and incidence are generated through the MoH reporting system that connects SNEM and MoH subcentres through the Department of Epidemiology. Although Municipal health clinics, hospitals and vector control brigades come into contact with dengue cases and at-risk neighbourhoods, they do not contribute their data to the overall statistics. This results in a problem of underreporting, to which private clinics also contribute in a similar way.
Table 8 – Degree, closeness centrality and betweenness centrality for identified actors in the Machala Network

<table>
<thead>
<tr>
<th>Actor</th>
<th>Betweenness Centrality</th>
<th>Closeness Centrality</th>
<th>Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal Government</td>
<td>269.06</td>
<td>1.76</td>
<td>25</td>
</tr>
<tr>
<td>SNEM National office</td>
<td>171.28</td>
<td>1.91</td>
<td>17</td>
</tr>
<tr>
<td>Health Area (MoH)</td>
<td>166.62</td>
<td>1.94</td>
<td>18</td>
</tr>
<tr>
<td>UBC</td>
<td>122.17</td>
<td>2.35</td>
<td>14</td>
</tr>
<tr>
<td>Prov. MoH</td>
<td>116.38</td>
<td>1.85</td>
<td>21</td>
</tr>
<tr>
<td>Residents</td>
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<td>2.35</td>
<td>17</td>
</tr>
<tr>
<td>SNEM Regional office</td>
<td>84.16</td>
<td>1.94</td>
<td>17</td>
</tr>
<tr>
<td>Provinicial M.Ed.</td>
<td>82.74</td>
<td>2.09</td>
<td>12</td>
</tr>
<tr>
<td>SNEM Machala</td>
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<td>2.29</td>
<td>16</td>
</tr>
<tr>
<td>Provincial Government</td>
<td>74.80</td>
<td>2.12</td>
<td>18</td>
</tr>
<tr>
<td>Schools</td>
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<td>2.21</td>
<td>12</td>
</tr>
<tr>
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<td>2.41</td>
<td>8</td>
</tr>
<tr>
<td>Neighbourhood Councils</td>
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<td>2.32</td>
<td>16</td>
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<tr>
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</tr>
<tr>
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<td>10</td>
</tr>
<tr>
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<td>27.08</td>
<td>2.32</td>
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<tr>
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<td>2.44</td>
<td>7</td>
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<td>3.00</td>
<td>5</td>
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<tr>
<td>Municipal Mobile Clinics</td>
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<td>6</td>
</tr>
<tr>
<td>Municipal Public Works</td>
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<td>2.74</td>
<td>2</td>
</tr>
<tr>
<td>National Police</td>
<td>0.00</td>
<td>2.82</td>
<td>5</td>
</tr>
<tr>
<td>IDRC</td>
<td>0.00</td>
<td>3.24</td>
<td>6</td>
</tr>
<tr>
<td>WHO-TDR</td>
<td>0.00</td>
<td>3.24</td>
<td>6</td>
</tr>
</tbody>
</table>

With contextual understanding then, the high betweenness centrality of the Municipal Government can be understood as pertaining more to services and less to information sharing and knowledge valuation, and as a mixed influence of barriers and bridges to improved community-based dengue prevention and control in Machala.
A cluster of actors and groups of actors follows the Municipal Government in high measures of betweenness centrality: SNEM National Office, the MoH Health Area, the University of British Columbia, the Provincial Director of Health, neighbourhood residents and the SNEM Regional Office (Table 8). The position of UBC within this cluster of actors is established through its role in the EBS-Ecuador project, and through my involvement in the EBS-Ecuador Social Analysis arm via the elaboration of this thesis. It should be noted that UBC’s involvement is not an organic product of routine process, nor does it independently influence communication patterns or information sharing. Rather, UBC offered coordination support as well as social research collaboration\textsuperscript{14} - and perhaps provides a proxy for the presence of an explicit and identifiable coordinator/facilitator function. The remaining actors in the cluster are implied to have the most influence with coordination, communication dynamics, information sharing, and through the combined influence in these three areas likely have great influence on knowledge valuation schemes as they pertain to dengue prevention and control. Interestingly, this cluster of 5 actors underscores the importance of equitable community participation and partnership; they essentially represent the interface of dengue prevention and control decision-makers and neighbourhoods. Importantly, neighbourhood councils are not included in the "residents" stakeholder group; they are 13\textsuperscript{th} on the list. This provides insight into the kind of community participation that is required for successful intersectoral coordination and collaboration. Authorities must coordinate with the residents themselves through a broad, equitable and respectful interface over time, rather than spot-checks and short reports shared with neighbourhood presidents alone with expectations that they will relay the information. Betweenness centrality measures seem to suggest that equitable partnership between these 5 actors

\textsuperscript{14} It is important to note that UBC’s motivations as part of the research team, in fact are to influence knowledge valuation in the implementation-evaluation and research-to-policy process through the work presented in this thesis and through results-sharing in collaboration with UASB, UTM, SNEM and the Ministry of Health. The results-sharing and policy recommendations have not begun at the time of the writing of this thesis as the EBS-Ecuador project is still in the implementation phase.
with research support would facilitate intersectoral coordination with the rest of the actors in the Machala Network.

Closeness centrality can be seen as an indicator of independence within a network; it is a measure of distance between an actor and all other actors in a network. A closeness centrality measure of 1 is significant of total independence within the network; this actor would be able to reach all other actors in the network without the aid of any other actors as intermediaries. The actor with the lowest closeness centrality measure in the Machala Network, and thus the most independence, is also the Municipal Government. Independent authority structures, resource pools, service delivery, information and evaluation systems, as well as political motivations, allow the Municipal Government to operate and fulfill its mandate without dependence on partnership with most of the other actors in the Machala Network. The cluster of actors that follows consists of: the Provincial Director of Health, SNEM National Office, the MoH Machala Health Area, SNEM Regional Office and the Provincial Director of Education. The six actors with the lowest closeness centrality also possess a large amount of decision-making power and administrative authority. In this sense, closeness centrality in the Machala Network can be understood as authority and independence of decision-making. Residents rank 14th and neighbourhood councils rank 16th out of 35 actors in the network in terms of authority and independent decision-making ability as it pertains to dengue prevention and control. This is illustrative of two things:

1) The current power structures that govern dengue prevention and control as it is, and the potential shift toward community-based and participatory dengue prevention and control programs, can independently reach the vast majority of stakeholders in the network and make decisions without the need to interact with residents, neighbourhood councils or government functionaries. This paternalistic power and decision-making structure within the Machala Network also pertains to information sharing, messaging and priority setting.
2) The power structure of the Machala Network is such that the formation of equitable partnerships between decision-makers, communities and the private sector to improve the determinants of dengue transmission risk and community-based participatory dengue prevention and control programs, is at the mercy of the political will of a small group of actors. Without intentional investment in equitable process on the parts of these elite actors, the endeavour will likely not be successful regardless of merit.

Machala may present a special case, or a particularly advantageous health research model, in that core members of the research team for the EBS-Ecuador project belong to both of these centrality clusters. That is to say, these powerful and politically visible actors do have an orientation toward an ecosystems-focused conception of human health that includes a vision for equitable community partnerships and equitable process.

4.2.2 Three-in-one network model
The overall Machala Network can be teased apart for the clearer visualization of stakeholder interaction and the structures that underlie the social and political mechanisms that determine and contribute to dengue risk, prevention and control. Understanding how actors engage with these structures is important for strengthening partnerships to support the research-to-policy process and perhaps foment positive change in community-based participatory dengue prevention and control strategies. Natural groupings within the Machala Network work along disciplinary lines, according to administrative hierarchies and institutional boundaries, and incorporate different parts of the overall knowledge-to-action and research-to-policy processes. Three sub-networks important to the research-to-policy process pertain to i) information sharing (how information relevant to dengue prevention and control is managed, used and valued); ii) service provision (how activities for control and prevention of dengue are carried out and evaluated); iii) and policy-making (how the systems involved in dengue prevention and control are regulated and governed).
4.2.2.1 Dengue information network

As discussed in previous sections, the dengue information network (Figure 10) has been subject to information bias and a technically/biomedically oriented knowledge valuation scheme, with information most systematically collected by the MoH/SNEM vector control program for the presence of the mosquito vector and the MoH health system for diagnosis and care for those affected by the dengue virus – and with limited information sharing between these programs. Generally, both quantitative (gathered through official instruments with the end of arming decision-makers with indices) and qualitative (experiential knowledge, context-specific issues/complaints and story gathered anecdotally without the aid of official instruments and info systems) information are gathered through government functionary-community interfaces and filtered upward through a “refining” process.

Figure 10 – Information network as it pertains to dengue and dengue services in Machala
This refined, mostly technical information is then used by decision-makers at the top of the informational and authority hierarchy to inform the making of decisions and design of responses to community needs through a deductive process. These decisions trigger a cascade of messaging, organization and service delivery back down through the hierarchy, the end product of which is the provision of services at the government functionary-community interface. The cycle resumes according to service delivery schedules, alarming epidemiological or entomological data trends, temporal administrative reporting cycles and with local-level monitoring and evaluation subject to the specific attention paid to competing alternatives (which may or may not be explicitly considered). The pockets of story and qualitative information that exist at the lower levels of the hierarchy rarely proceed to the decision-maker level without direct personal interface; a previously discussed example of this is the practice of neighbourhood presidents directly demanding audiences with decision-makers to emphasize the urgency of public health crises in their communities.

4.2.2.2 Dengue services network
The dengue services sub-network (Figure 11) has been mapped with an expanded definition of “dengue services” that includes the provision and maintenance of basic infrastructure, sanitary infrastructure and basic services. The Municipal Government appears as two separate entities in this sub-network map to illustrate the division of responsibility and the vertical, exclusionary view of what constitutes dengue prevention services under the authority of the Municipality. Indeed, the purpose of this work, as well as of the EBS-Ecuador project, is to support consideration of a broadened view of dengue, its determinants and determination in Machala. The divide within the Municipality between the Department of Public Works and the Department of Health is as equally prominent as the divide between Ministries in that system. Although the Municipality is a smaller organization, it is structured in a similar way, with vertically oriented departments and vertically implemented programs. With seasonal dengue prevention and control activities, the responsibility of the
Municipality is largely seen as the provision of basic infrastructure and services. The Ministry of Health, through SNEM and the primary care delivery system, provides year-round dengue prevention and control services largely consisting of monitoring of mosquito vector infestation and dengue incidence, source-reduction messaging campaigns and application of chemical and biological insecticides. Despite the constant effort, only 30% of Machala is covered by services at any one time, with special consideration and prioritization of at-risk neighbourhoods. For suspected and confirmed dengue cases, attention and care are provided by clinics, medical offices, and hospitals in the community.

Figure 11 – Dengue service provision network in Machala

As discussed in previous sections, there is a vested interest within this network to shift toward a more equitable, community-based, participatory dengue prevention strategy that would see residents and their neighbourhoods as implementation partners. The government functionary-community interface is an important driver of this paradigmatic shift in service provision. There is a movement within the
body of SNEM that has been encouraging brigade workers, and brigade chiefs in particular, to ask for feedback from residents and to submit contextual observations with their quantitative entomological reports. As well, community health inspectors are encouraged to gather contextual observations and narrative during epidemiological surveys prompted by confirmed dengue cases. That is to say, there is an increasing awareness within this network, especially at the middle and lower levels of the power hierarchy, to include community voice, experiential knowledge and story, and to try to connect residents with other entities or programs to address needs other than dengue. If this sentiment is to grow, and political will toward equitable community participation and intersectoral collaboration to improve, this kind of inclusion of qualitative information uptake will have to be adopted by mid and upper levels of the hierarchy, and will have to be steadily improved.

Part of the motivation to further include qualitative data and experiential knowledge in data collection and decision-making in this sub-network is driven by an interest in improving effectiveness of services and programs through improved implementation strategies. A government functionary that can provide increasingly effective services in a shorter period of time, that will address the needs of residents and neighbourhoods while creating good relationships through inclusion of community knowledge, will not only improve health outcomes in the shorter term, but will also be welcomed back more readily in the long term. This translates into ease of executing one’s job, increased social capital and visibility of health workers in neighbourhoods and, hopefully, a reduced workload through improved community health. This vision of practical impact is quite different than that of a decision-maker who may be removed from the day-to-day reality of dengue, where decisions are made with arms-length measures of efficacy that may or may not be easy to implement or readily accepted by the “intended beneficiaries" or residents.
4.2.2.3 Dengue policy network

There are two separate policy networks in Machala as the ministry system and the municipality do not share common vision, information or specific motivations to address dengue; the ministry system dengue policy network (Figure 12) and the municipal dengue policy network (Figure 13). Interest in a paradigmatic shift toward EcoHealth-style or EBS-type programming has not occurred to the same degree within the Municipality as it has within the Ministry of Health. There is also a growing acceptance of and interest in a shift toward critical epidemiology and a more holistic view of human health within the Ministry of Health; certainly, within the ministry system there has been an increase in skilled human resources focusing on social and environmental determinants of health, including within the Ministry of Environment.

Figure 12 – Ministry system policy network for dengue in Machala
The dengue policy networks reflect the dengue information network quite closely, emphasizing the link between technocratic information bias and the questionable responsiveness of policy to identified community needs. Although quantitative, technical, biomedical information is generally the driver of new policy, qualitative information and community knowledge has become increasingly important within the Ministry system under the concept of *Buen vivir* in the Ecuadorean constitution. *Buen vivir*, or “living well”, has been put forward by the constitution written in 2008 as a design for development and positive change for governance, institutions, industry and people characterized by sovereignty, equity, equality justice and respect for nature; also giving more explicit identification of the living conditions that can affect holistic well-being rather than considering health purely as healthcare [284]. This new design for living, working, being and collaborating recognizes that systems will only work in a positive and emancipatory way if they are collectively conceived and built, and that policies must express the values of the collective to be effective. That is, the principles must be applied to counteract the current development model of economic dependence, social injustice, environmental degradation and subversion of democratic process [119].

*Figure 13 – Municipal policy network as it pertains to dengue control in Machala*
The dengue policy sub-network for municipal actors is far more restricted in terms of budget and political vision than the Ministry system. Although the Ecuadorian constitution still applies to municipal governments, the rhetoric and discourse around service provision and development within the Municipal Government of Machala is far less oriented toward the ideals of *Buen vivir*. As described in previous sections, limited political will, legal battles and lack of coordination severely limit the Municipality’s ability to act quickly and to fulfill their mandate. These same impediments to progress and differing cultures complicate the policy-making process.

### 4.2.3 Intersectoral spaces and macro-sector boundaries

Intersectoral spaces do exist in the Machala Network and intersectoral collaboration is accepted as both a goal to work toward and an essential strategy to deepening understanding around complex issues, creating robust relationships with communities and improving the responsiveness and agility of government policy-making and service-delivery structures. However, intersectoral spaces in the Machala Network are restricted by division of political jurisdiction and by vertical information systems.

Intersectoral spaces exist within macro-sectors, like the Ministry System or the Municipal Government, but rarely cross macro-sectoral boundaries. There are good relationships between the Ministry of Health, Ministry of Environment, Ministry of Education, Ministry of Children and Social Inclusion and the Ministry of Urban Development and Housing; there are frequent collaborations to promote health programs, healthy living, and improve social conditions and human security issues\(^\text{15}\). As well, collaborations are frequent between the Departments of Health, Education and Environment within the Municipal Government; often,

\(^{15}\) Two great examples of these intersectoral spaces are collaborations between the Ministry of Health and Ministry of Education on dengue prevention and nutrition health promotion/education in schools, and the collaboration between the Ministry of Environment and the Ministry of Health, partially through SNEM, to monitor the effects of climate change on infectious disease risk factors and transmission (with partial focus on the increasing dengue risk in the Southern Ecuadorian highlands).
collaborative events include Municipal Police to promote security and social safety. The vast majority of these collaborations do not include equitable community participation, with neighbourhoods and residents acting as full partners.

Intersectoral spaces within the network rarely cross these macro-sector boundaries; they are defined by information networks and political jurisdiction, these boundaries are not easily overcome. It would require an investment of time, and resources, neither of which is in abundance for the Ministry of Health, SNEM, the Municipal Government of Machala or communities. Collaborative and functioning intersectoral spaces are needed between communities, the Municipal Government, Triple Oro, the Ministry of Health and SNEM. As illustrated by centrality measures, a close partnership between these actors and universities (as a support if not catalyst) is important to support the construction of intersectoral space and the development of tools that will improve equitable participation and knowledge valuation schemes. It is also important that the principal university actor is local, as it will strengthen the capacity to seek out new opportunities for intersectoral collaboration and innovation in information sharing that may facilitate meaningful and equitable consideration of experiential knowledge and qualitative information at the decision-making level.

Intersectoral spaces are varied in terms of purpose and amplitude, however, they often follow officially established protocols. For example, most of the intersectoral spaces within the system of ministries are facilitated through formalized collaboration agreements at the administrative level. That is, they are coordinated in accordance with the hierarchical organization of the existing systems. These spaces are occupied by the narratives and cultures of the organizations that inhabit and work within them. Organizations are governed by policies, which are embedded within law, jurisdiction, mandates, regulations and guidelines [253]. Cumbersome bureaucratic processes limit accessibility of intersectoral spaces to multiple and diverse stakeholder groups, as indicated by
the relatively sparse nature of the social network map. The existence of intersectoral space does not necessarily imply productivity, equity or functionality. Although beyond the scope of this thesis, an evaluation of intersectoral spaces, how they are defined and how they interact with the policy-making process as it pertains to the scale-up of the proposed participatory dengue prevention program would be an important next step.

4.2.4 Communication patterns and knowledge translation

The general communication pattern for the Machala Network is defined by rich information filtering up through the decision-making hierarchy and becoming increasingly distilled, with messaging trickling back down through the same actors. Betweenness centrality measures discussed in section 4.2.1, infer the capacity of key actors to influence information flow through relationships with other actors in the network; this influence may also contribute to information bias depending on the orientation of each key actor.

Robust information systems that accommodate varying kinds of information and support equitable community participation are crucial to the reversal or limitation of paternalism in dengue prevention and control in Machala. Making sound qualitative data and experiential knowledge available in an accessible and efficient manner might significantly affect the information biases in current government administrator decision-making practices in Machala. A common thread joining the experience of all involved administrators is limited time and a large burden of work. Decision-makers use readily available information that is clear, reliable and rigorous to inform their decisions; no tools are currently in place to ensure the availability of experiential knowledge and qualitative data in a rigorous and timely manner.

Information systems can also serve to create trust and bridges to intersectoral collaboration where there are poor relationships and frustrated attempts at achieving common goals. In the example given by the Municipal Government of Machala and Triple Oro, an information system allowing for common access to
planning timetables and providing a forum for collaboration and negotiation could improve coordination of development and service delivery activities. In the further example of the underreporting of dengue cases, both suspected and confirmed, a common database with point-of-service access for private, municipal and MoH clinical practitioners could ameliorate a large part of the issue and provide more timely surveillance to guide control and prevention actions.

4.3 Sociocultural dynamics in community-based dengue prevention and control: Illustrative vignettes

Exploring complex dynamics through real-life situations deepens understanding of systems, interactions and challenges, and invokes a practical or applied dimension to that understanding [286]. Similar to a case-study approach, illustrative vignettes are drawn from the experiences and events described through interviews, focus groups, community meetings and ethnographic observations [105]. The following illustrative vignettes seek to further explore and describe identified social and cultural dynamics, and to contextualize them with respect to participatory dengue prevention and control programs in Machala. Contextualization of theory or theoretically described elements in a real-life complex network of systems requires interpretation with specific reference to local context [155]. The following illustrative vignettes are designed to carry the interpretivist, emancipatory nature of action research and participatory methodology through the indicator and KT model development, and provide a real-world anchor to theoretical analysis.

4.3.1 Vignette 1: Quemeimportismo, evaluation and paternalistic assumptions

Social and cultural dynamics affect the way that stakeholders and stakeholder groups interact with one another, and collaborate to address complex challenges. Macro-level political, economic and social forces also come to bear on the local context through imposed power structures and agendas, influencing the ways that knowledge is used to generate evidence and how evidence is interpreted to describe the problematic of participatory dengue prevention and control in
Machala. Understanding real world issues through the use of indicators is always limited by the partiality of the evidence; a more holistic understanding requires multiple kinds of indicators and contextual appreciation for determinants of the trends the indicators show. The assumption that indicators alone paint a holistic picture is most limiting of all, particularly if the championed indicators are divorced from the daily experience of the community.

The MoH and SNEM use community meetings as part of health promotion and preventive health campaigns to share messaging, ask for participation and to establish practical presence of the programs in the involved neighbourhoods\textsuperscript{16}. Particularly in the case of participatory community health interventions, these meetings are used to gauge acceptance, willingness to participate and the sustainability of community participation over time. Meetings are usually coordinated by mid to low-level government administrators and neighbourhood councils, and residents are invited to attend by door-to-door notices and/or megaphone announcements in the streets. Attendance is taken at each meeting, both to track the number of residents participating in each meeting and to identify engaged individuals over time. However, using attendance sheets that show dwindling numbers of community attendees over time, without understanding the personal experiences of invited residents only provides limited insight into factors affecting community participation.

“People who seem the most enthusiastic at the first meeting, the ones who collaborate most and the ones, let’s say, that are most convinced of what they will do, it’s ideal if they are the community leaders. But very often, they begin to lapse and hesitate to commit to future action. But, I mean, the only way is to measure over time, we haven’t found another way.” – Government administrator interview

\textsuperscript{16} The dynamic of poor attendance at community meetings was already well established in the shared experience of MoH, SNEM, neighbourhood councils and neighbourhoods at the inception of this study. As such, the dynamics and perceptions discussed in this vignette are not unique to the EBS-Ecuador project, nor are they unique solely to health-related meetings. Meetings organized by the Ministries of Health, Education and Environment, by the Municipal Mayor’s Office, Health and Environment Departments, and by Parish and Neighbourhood Governments to address a wide array of issues far precede the advent of the EBS-Ecuador project.
“At the resident level, it’s hard to know their attitudes, their motives for not attending meetings. Because it’s great that they say ‘I’m going to go’, but, well, they don’t come. They don’t attend.” – Neighbourhood president interview

Meeting attendance sheets provide a readily accessible and easily measurable source of information about an aspect of community participation. Persistent low meeting attendance despite concerted efforts to make meetings accessible, programs interesting, provide notification and incentive to attend adds to the perception that communities are apathetic toward participatory programs to improve community health. From the perspective of government functionaries, administrators and decision-makers, low meeting attendance is resonant of the dynamic of Quemeimportismo, which is borne out through persistently high vector indices and the changing epidemiology of dengue fever in Machala. Both meeting attendance and the presence/absence of mosquito larvae and pupae in and around residents’ homes measure “evidenced” or “inferred” participation; decision-makers see the end product of effort expended, or lack thereof, to support the participatory dengue prevention program. Paternalistic assumptions about valid participation are then used to draw conclusions extrapolated from these point observations: assumptions like if people understood the importance of the program to their own health they would comply; and people should change their behaviours and ways of life under the direction of expert opinion because it is the best thing to do. For example, if a signature appears on a meeting attendance sheet, there is evidence that a person accepts the program, had participated in discussion and decisions at that meeting and would then act as an agent within their own home and neighbourhood for positive change in accordance with program objectives. If Aedes pupae and larvae are found in the water tanks of a home at the time of inspection, the family may be assumed to be negligent of their own well-being, and is ignorant about dengue and the consequences of their actions. In both of these cases, the narrative behind the evidence is missing.

The community participation, empowerment and well-being survey paints a different picture of what meeting attendance may mean. Respondents (n=1888)
indicated that opportunities to meaningfully participate in dialogue and decisions regarding participatory dengue prevention and control programs, and expressing opinions truthfully to decision-makers were weak (see section 5.2.2 for further exploration of these results). Dialogue at community meetings is nearly always framed and directed by government functionaries, administrators or researchers; subject matter and language are narrowly focused on program objectives. Community participation in these dialogues is then limited by what the facilitators want to address and to whom the facilitators “give the floor”. Incentives are often given to participants in order to boost attendance, snacks and chlorine bleach for water purification given at the close of the meeting entice people to stay. In light of these other factors, then, we can conclude that the presence of a person at a community meeting as evidenced by a signature on an attendance sheet may indicate a wide variety of experience, intentions, and ways of participating. One participant may have come for the opportunity to actively engage with the dengue prevention program and to encourage her neighbours to do the same. Another participant may have come for the opportunity to protest the time, money and resources expended on a relatively unimportant health problem in the neighbourhood, when what they have been struggling for is a community policing detachment; this was repeatedly the case in one of the 20 neighbourhoods participating in the EBS-Ecuador project. Yet another participant may have come late and stayed just long enough for the benefit of the chlorine. Each of the three signatures appears the same at face value, but carry very different implications for participatory dengue prevention and control. On the other hand, the absence of a signature is interpreted as apathy, ignorance or deprioritization of the entire program.

The participatory indicator development process explored more fully in chapter 5 of this thesis provided a natural opportunity to investigate the validity of using meeting attendance alone as an indicator for community acceptance and investment in participatory dengue prevention programs. As described in Chapter 3, sixty community participants were randomly selected from five different neighbourhoods engaged in the EBS-Ecuador project to assign value to
candidate indicators, attend a results-sharing and development meeting, and receive a follow-up phone call regarding the process. At the time of completing the indicator valuation survey, each participant received a written invitation to an evening meeting the following week to be held at their neighbourhood community centre. They also received a phone call or visit at their home the afternoon of the meeting to remind them of the event. Turnout for these five meetings was low with only 11 of the 60 invited participants attending, possibly indicating a disempowered and disinterested group of community stakeholders. Particularly when situated within the broader experience and discourse of dengue prevention and control in Machala, these results could very easily be interpreted as apathy or Quemeimportismo.

“First of all, communities have to attend the meetings organized by the health teams or by the authorities. But a lot of the time, the authorities and the health teams make the meetings at times that don’t work for the community. The don’t use language that works for the community either.”

– Key informant interview

Following up with the 60 community participants revealed that the main reasons given for not attending the meeting were lack of childcare, family illness, and evening work shifts. Furthermore, 82% believed that their opinions would be used in project evaluation, 70% believed that their opinions would be considered by authorities beyond the scope of the project and 85% expressed willingness to participate in further follow-up and evaluation processes. This is a very different picture; an engaged group of actors unable to attend one event in a series of exercises due to circumstances more-or-less unrelated to their opinions or attitudes toward the process of indicator development for participatory dengue prevention in their own communities. The contribution of the narrative of front-line workers is no less important in the perpetuation or interrogation of Quemeimportismo. Some of the more engaged community collaborators were unable to attend the meetings in question, however, their engagement with the EBS-Ecuador project overall was strengthened as a result of their participation in the indicator development process. In other cases, respondents for whom spending the time to complete the indicator valuation survey was inconvenient
because of other commitments, attended and participated in the results-sharing meetings. Assumptions about community participation based on interaction in one aspect of a program, may not hold true for the same individuals or groups in for other aspects or activities. Experiential and qualitative knowledge allow these assumptions to be challenged; without understanding the narrative behind an event, richness and opportunities to build relationships and innovative partnerships are lost.

The community participation, empowerment and well-being survey results portrayed a disempowered community that believed that it had very little to no power to influence health programs in its own neighbourhoods. The 20 neighbourhoods of the wider EBS-Ecuador project did not have the benefit of being involved in a participatory process where their opinions were valued and applied in the building of evaluation tools for the express purpose of affecting project decision-making and future considerations for scaling-up. Although meeting attendance was typically low for the participatory indicator development process, the complementary knowledge about the narrative behind the lack of attendance illuminates a different picture. Community collaborators for the indicator development process were engaged, invested and hopeful about the effect their participation would have on the larger project. The qualitative and experiential knowledge gathered through this participatory process urges decision-makers to consider meetings as one-time events that are bound by place, space, time and politics. Meeting attendance alone may provide very little information useful to describing or measuring community participation.

4.3.2 Vignette 2: Paternalism in socially-minded KT and the “know-do gap”
Knowledge translation rhetoric often refers to a “know-do gap”; this term may be used to describe different kinds of gaps that exist between what we know and what we do. Because the concept of KT has been largely developed in the health disciplines, reference to the know-do gap is often accepted as describing the dissonance between validated research knowledge and health care practice and service delivery [287, 288]. In global health, the know-do gap may also refer to
the lack of transference of knowledge from one world region to another in order to replicate successes, or the ineffective application of knowledge evidenced through unchanging pessimistic indicators of human health [287]. A healthy debate exists in scholarly literature as to why these know-do gaps prevail even in the face of increasing attention to participatory research paradigms and increasing innovation in KT processes. Global health presents a unique set of challenges through macro-level power and funding structures. Research and development agendas are often determined by funding schemes and economic interests of international or global actors that are distant from local issues. These “driving force” (DPSEEA framework) decision-makers routinely act without integrating knowledge from the local context resulting in a lack of “needs-driven” research, integration of knowledge generated through local development projects and experience, and a lack of local ownership of knowledge and innovation [289].

When considering the know-do gap in the context of participatory dengue prevention and control programs, the lack of local ownership of knowledge and innovation may serve to reinforce the cultural dynamics of paternalism and quemeimportismo. Dengue transmission risk in Machala is often measured through entomological indices which reflect the current strategy of mosquito-breeding source reduction campaigns. Current research for dengue prevention often hinges on increased community participation for the reduction of domestic and peri-domestic vector-breeding habitat. So, if larval and pupal indices are low, the source reduction campaigns may be seen to have been successful, and the translation of research evidence to effective practice to have been achieved. This sets the community in a precarious position; if entomological indices are high, the knowledge has not been applied correctly and the community has not fulfilled their role in reducing vector-breeding habitat. Victim blaming can result, and as is the case in Machala, the “know-do gap” is transformed into a dissonance between what the evidence states should be done, and what the community is doing. A significant “know-do gap” was identified by the EBS-Ecuador project in Machala, it was found that over 90% of respondents of the household survey
(n=1996) had a working knowledge of dengue, its vector and its transmission cycle, but there were still significant pupa per person index (PPI)\(^{17}\) measures for most of the 20 neighbourhoods included in the study, as well as persistently high dengue incidence for the city of Machala. This echoes the experiences of government functionaries shared in focus groups and interviews; the people of Machala know about dengue, have been repeatedly educated regarding the hazards of standing water as vector breeding habitat, yet containers infested with *Aedes* larvae and pupae continue to be found.

Globally, there has been intensifying interest and increasing bodies of work around addressing the “know-do gap” by looking for practical and applied approaches packaged in easily digestible bundles of quantitative research tethered to communities by a qualitative thread. In fact, one of the over-arching goals of the multi-country EBS-LAC study is to identify “most productive container types” in the seven different participant countries, and to then tailor interventions to target the specified container types for maximum impact on dengue transmission risk measured through the PPI. In theory, streamlining interventions and simplifying participation directives to focus on one or two container types ought to mitigate a larger proportion of dengue transmission risk than a general source-reduction campaign. The EBS-Ecuador project was interested in understanding how social determination affects dengue transmission risk for different social strata. Breilh et al (2010) developed the new social insertion index (INSOC) that offers a more comprehensive view of social strata that includes migration, financial autonomy, gender, housing quality as well as socio-economic indicators in order to more clearly understand determination.

\(^{17}\) The PPI is an index that measures the number of *Ae. aegypti* pupae (the final aquatic immature stage of the mosquito’s life cycle before it ecloses) in a given household or area per person; this is important in that mosquito vector density in a given area is a determining factor for dengue transmission. The higher the vector densities, the more easily and quickly dengue virus can be transmitted from a single index case to multiple susceptible people in the area. Although the PPI index is relatively new, it is seen to be a more effective index for predicting real dengue transmission risk than other entomological indices. The literature on the use of PPI in predicting dengue transmission risk considers a PPI of 1.0 or higher to be in the realm of epidemic transmission risk, whereas a PPI value of 0.99 or lower would be endemic transmission risk gradually decreasing to zero transmission risk in the absence of vectors.
of dengue transmission risk. The development and application of the INSOC was a marked advance for the EBS-Ecuador project in that a clear correlation was found with INSOC, “most important breeding container type”, and PPI for the 20 participating neighbourhoods [290].

The idea of important container types and their socio-ecological placement within INSOC strata proves to be an interesting case study on cultural and paradigmatic blind spots within the Machala network, and perhaps beyond. The 20 participating neighbourhoods were grouped into higher, middle and lower INSOC strata for the purposes of the analysis. The type of container that produced the largest proportion of Aedes pupae in neighbourhoods of the higher INSOC strata were smaller jugs, cups or pots with a total volume under 5L. Basins, tubs or buckets of 15 to 25L in volume were most productive for neighbourhoods of the middle INSOC strata, and large, ground-level domestic-use water tanks of 200L or more were most productive for neighbourhoods of the lower INSOC strata. When this data is overlayed with neighbourhood access to the municipal water network, a narrative of social determination begins to emerge. Neighbourhoods of higher INSOC strata enjoy better quality housing with access to basic services, piped water and sanitary and storm sewer networks, thus, they don’t have the need to store domestic-use water in large tanks in their homes. Smaller pots and jugs contain “incidental” standing water that is not vital for the day-to-day needs of residents in the home. The medium-sized basins and buckets important for middle-strata neighbourhoods are often used for laundry, washing fruits and vegetables or sometimes cleaning the home. The water in these basins may be stored for a few days at a time as homes in these neighbourhoods may have only intermittent access to municipal water. Neighbourhoods of the lower INSOC-strata generally have no reliable access, if any, to the municipal water network and may rely on delivered and collected water to meet their daily needs. The water in the large ground-level tanks is essential to all daily needs of the residents in the homes; it is not uncommon to have multiple 200L ground-level tanks to meet the weekly needs of a large, multi-generational family.
Reliable access to clean water and sanitary infrastructure through municipal networks directly determines vector-breeding habitat in Machala. As discussed in previous sections of this chapter, the dynamics of centrismo and amiguismo (centrism and nepotism) affect the distribution of basic services and access to water\textsuperscript{18}. Inequitable distribution of services determines inequitable distribution of dengue transmission risk. Containers can affect entomological indices in two ways: container quantity within a given geographic area and individual container capacity for production of mosquito adults. Logically, if there are more mosquito-breeding containers in a given area, there will be a larger ambient mosquito population. As well, if a container holds a larger volume of water it may produce more mosquitoes than a container holding a smaller volume of water. Both of these factors come together in lower INSOC-strata neighbourhoods, there are more containers holding larger volumes of water when compared to the other strata (966 ground tanks in lower strata compared with 805 basins in medium strata and 563 pots in higher strata) [291]. The PPI comparison between strata clearly shows the multiplicative effects of size and number of containers; high strata neighbourhoods had a rainy-season PPI of 0.08, while middle and lower strata neighbourhoods had rainy-season PPIs of 1.66 and 1.63 respectively. In essence, the inequitable distribution of basic services and reliable access to water determines that neighbourhoods of lower INSOC strata are perpetually at risk for epidemic dengue transmission, while those of higher INSOC strata are not.

\textsuperscript{18} Communities with limited or no access to basic services and the municipal water and sewerage network tend to be further away from the centre of Machala. This geographic distribution of inequity also applies to some of the services offered by the SNEM vector control headquarters located quite near the centre of the city. The temephos larvicide Abate \textregistered is available free of charge to Machala residents for use in their domestic water storage tanks and cisterns. Vector control personnel distribute the granules during home visits, but as these are sporadic and routinely only cover 30-40\% of the affected areas in a year, residents must travel to the SNEM office during working hours to collect it themselves. This renders the government-sponsored service of larvicide provision essentially inaccessible to peri-urban residents, and greatly increases their entomological risk profiles.
Funders, government administrators, functionaries and researchers may see the correlation of PPI, INSOC and container type as a hopeful finding that facilitates targeted interventions and streamlined community participation. Improved messaging, educational materials, human resource training and follow up should have a greater impact for dengue prevention. However, targeted messaging and re-focused interventions do not necessarily address the identified “know-do” gap in Machala. Productive containers persist despite continuous messaging for source reduction campaigns, more paternalistic messaging to an already aware and educated population may not be the answer. “Empty this tank, not that tin!” and “Watch that basin, not that pot!” is more of the same from the point of view of the resident. The implications of the findings should run much deeper than improved messaging, they should run to the heart of the economic, social and development policies that systematically deny thousands of Machalan residents the right to health through deprivation of their basic need for reliable access to water.

Funders and decision-makers focus the crux of their arguments on the fact that dengue transmission still exists in places that have piped water, sewers and paved roads\(^\text{19}\), implying that the final solution to dengue lies elsewhere. However, if the evidence was examined through the frame of social justice and health equity, it is clear that in Machala reliable access to water is a major determinant of dengue transmission risk. If funders, decision-makers, communities and researchers focused effort, time and funding on equitable provision of basic services and access to water for high-risk neighbourhoods the transmission risk could perhaps then fall from a constant risk of intense or epidemic transmission to a level considered “manageable”. Extending this

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\(^{19}\) This statement reflects ethnographic observations made during an international meeting to discuss the multi-country results of the EBS-LAC initiative. The presented social analysis as part of the results from the Ecuador team underscored the importance of the responsibility of research to apply pressure for the provision of basic services and reliable access to water as primordial dengue prevention measures. A decision-maker representing one of the funding agencies replied that dengue transmission still exists in places that have access to basic services, water and sanitary infrastructure, so, it is more important to focus on containers because people will always have containers of one kind or another.
argument into the realm of policy, Spiegel et al. (2004) showed that investing in improving neighbourhood environments and human security indicators also improves human health indicators and community responsiveness to perceived health threats. The community of Cayo Hueso, an urban neighbourhood in Central Havana, Cuba, with very low health, housing and well-being indicators was the setting of a massive undertaking to improve quality of life. The Cuban Government and non-governmental organizations undertook improvements to the neighbourhood over 4 years: housing repair and improvement, revitalization of public and recreational spaces, repair of street, water and sewer infrastructure, improvement of solid waste removal, improved lighting in streets and public places, and increased social and cultural activities motivated by health promotion [291]. Serendipitously, after improvements were made in the neighbourhood, an imminent threat of a dengue outbreak and possible epidemic materialized. The community was able to mobilize quickly and work to contain the outbreak. The responsiveness and resilience of the community was credited to their improved quality of life and increased capacity for social mobilization. Investing in elements of human security impacts both individual and community health. Importantly the Cayo Hueso project was a government-sponsored initiative with engaged policy-makers, administrators, researchers, practitioners and community all acting together. In this sense, there is a “know-do” gap for funders and governmental actors as well, perhaps with more profound implications.

4.3.3 Vignette 3: Vacant lots, community health and the need for intersectoral collaboration
The 2008 Ecuadorian constitution provided a political framework to support the social shift toward more holistic concepts of human health [54]. A new emphasis has been put on using the concept of *Sumak Kawsay* or *Buen Vivir* to guide development and governance, as well as incorporating environmental and social determinants into a broader definition of health. *Buen Vivir*, directly translated as “good living”, holds a strong focus on equity, justice, sovereignty and the protection of the natural world [54]. As with theory behind EcoHealth and Eco-Bio-Social approaches, this new political vision holds that the health of people,
and indeed of communities, is intimately linked to their environment and to equitable access to resources, process and services. Although there is ongoing work and advancements are being made, establishment of policy and implementation of programs in the vein of *Buen vivir* is still in fledgling stages.

In Machala, a continuing shift toward EcoHealth style dengue prevention and control strives toward improved equity, justice and addressing of the social and environmental determinants of dengue risk; the strongest push toward this new paradigm comes from SNEM within the Ministry of Health. Dengue, however, presents a challenge to the vertically oriented system of governance and services that divides jurisdiction over the determinants of dengue transmission risk into disciplinary silos. Vector control, clinical management, public health messaging, solid waste management, water and sewerage provision, housing quality and neighbourhood security all contribute to dengue transmission risk, and all are managed by different governmental agencies at different administrative levels with clearly defined political and geographical jurisdictions. Addressing the complex challenges of participatory dengue prevention and control requires intersectoral collaboration, but mis-matched political agendas and lack of available bridge-building resources may frustrate practical undertaking of theoretically shared program priorities. Vacant lots as contributors to dengue transmission risk in Machala present a particularly illustrative example of the importance of aligning policy, governance priorities and paradigmatic orientations within the intersectoral space.

“The insalubrity here, for the people that live here, is vacant lots.” – Community focus group participant

Stakeholders repeatedly identified vacant lots as a community health hazard during focus groups, interviews and community meetings. In general, problematic vacant lots are owned by someone who does not live in the neighbourhood as an investment or with plans for future development. These lots are usually dispersed throughout neighbourhoods, situated within the community adjacent to lots with
inhabited homes. Often, the lots are labeled as “abandoned”, the connotation of neglect is intentional and describes both perception that vacant lot owners neglect their property and their responsibility as a citizen to protect the health of others by maintaining their property. Many of these lots are walled-in and locked, and as they are private property it is illegal for non-authorities to enter them.

Abandoned lots become garbage-dumping grounds in the absence of reliable and adequate solid waste management services, the containers and plastics in the dumped garbage then collect rainwater and become rich vector breeding grounds. Lack of necessary storm sewer networks in many of the highest dengue risk neighbourhoods allows water to pool and vegetation flourishes within the inaccessible lot. In addition to prolific mosquito-breeding habitat, vacant lot dumping grounds provide excellent environments for rodent and snake infestation, chemical contamination of soil and water run-off, and exposure of the community to disease-agents through the decomposition of carrion. Municipal garbage collection services will not pick up solid waste that poses a toxic or biological threat to their staff, leaving residents to find creative solutions to keeping dangerous waste in and around their own homes.

“Yes, [vacant lots] are a big problem because, for example, I can have my house clean, with nothing, but here beside me there is a vacant lot and it creates malaise for me, for any number of diseases.” – Government functionary focus group participant

Absent owners and their lots provide a physical space for the intersections of human health, social determination, quemeimportismo, social resentment, paternalism and intersectoral collaboration for improved health equity through better governance. Participatory dengue prevention and control programs rely on mosquito-breeding source reduction in and around people’s homes as well as in public spaces. The immense effort expended in participatory source reduction, and the government scrutiny of community behaviours and ways of living may amount to an exercise in futility while abandoned lots produce ambient dengue vector populations. Cases of dengue fever in a neighbourhood will trigger SNEM
and MoH epidemic-prevention measures that include door-to-door house inspections, source elimination and application of insecticides in the neighbourhood focused around the home of the infected person. If, however, the infected person lives beside an enclosed abandoned lot, source reduction becomes impossible and epidemic dengue transmission risk increases exponentially. The interface between dengue prevention and community experience becomes characterized by the social resentment of resident who are participating to the best of their ability to reduce risk, who are falling ill because of productive vector sources they are powerless to control and who perceive the government’s actions as hypocritical. Governments scrutinize community behaviour and ways of living, but repeatedly fail to exercise their unique power to control the public health hazards of vacant lots even in the face of persistent complaints from residents. This social resentment fuels the sense of disempowerment and futility, thus engaging the *quemeimportismo* dimension to this social dynamic.

“They have to apply the health act… It’s the same thing, as I was saying before there is a law about the vacant lots.” – Government functionary focus group participant

The Health Act issued by the Municipal Government of Machala to govern solid waste management states that [122]:

i) solid waste management within the geopolitical limits of the Cantón of Machala falls under the jurisdiction of the Municipal Public Utility (article 2)

ii) as such, municipal departments are obliged to address citizen complaints regarding cleanliness within the Cantón (article 10)

iii) all citizens are obliged to manage personal solid waste in an environmentally sound manner (article 18)

iv) owners of undeveloped lots must (article 20):
   a. enclose the lot to prevent unsanctioned garbage dumping and the generation of infectious disease risk
   b. maintain their lots in hygienic and salubrious condition
c. in the case that undeveloped lots are not kept in these conditions, the Municipal Government of Machala and its agencies reserve the right to bring the lot to standard, enclose it and recuperate the cost directly from the owner

v) The Municipal Government of Machala and its agencies may impose fines and penalties for conduct that poses a risk to common cleanliness and health (article 36)

These ordinances are housed within the legal and political jurisdiction of the Municipal Government of Machala and its agencies meaning that it is the sole entity that can enforce them. The Municipality is also the entity in charge of provision of basic services and infrastructure, however, it plays only a marginal role in the dengue monitoring, prevention and control programs under the control of SNEM and the MoH. The MoH primary care health centre system also provides the main interface for communities and government entities through their community health inspectors, who in turn, do not possess the authority to enforce the ordinances of the Municipal Health Act in order to address pressing public health concerns like infested vacant lots during a dengue outbreak. This convoluted cycle of blame and disjointed governance mechanisms easily begins and ends with the Municipality; the inequitable distribution of basic services causes the problem and the lack of enforcement of existing ordinances regarding vacant lots allows it to persist. Intersectoral spaces are needed to bridge the gaps between the Municipality and the MoH to find a sustainable, workable solution to this issue. Attempts by the Municipality alone have not been successful, largely because of the lack of resources to support a continuous enforcement program.

“The people don’t pay any mind, but this year we will be much more severe [regarding vacant lots]. In the next few days, we are publishing in the papers a list of people who have vacant lots that are dirty and full of weeds and standing water. They have to fill them in and close them up by a certain date. If they don’t, we will impose steep fines.” –Government Administrator Interview
Aside from the glaring issue of provision of basic services and infrastructure, the issues of governance and reporting are key. Ministry of Health and SNEM functionaries most frequently receive the reports and complaints regarding vacant lots, but there is no mechanism through which to meaningfully share these reports with the Municipality so that they can be followed up and addressed. The Municipality has both the legal capacity to enforce the health ordinances and access to vacant lot owners’ personal information but does not have the resources, both economic and human, to continually address the issue through the health commissioner’s office. This results in sporadic media-based campaigns that publicly name delinquent lot owners in an attempt to shame them into compliance. Granting ordinance enforcement authority to MoH and SNEM vector control functionaries and creating an integrated reporting system\(^\text{20}\) could facilitate the meaningful intersectoral collaboration necessary to address this issue in a way that directly responds to programmatic challenges and community needs – and provide a context for monitoring feasibility of such measures and their potential effectiveness. The MoH and SNEM functionaries are already skilled personnel on the ground in affected neighbourhoods. If they had the ability to issue warnings and fines under the authority of the Municipality, i) the ability to enforce health by-laws, respond to community concerns and act quickly in response to emergent public health threats would be increased without the need for an increased human resources budget; ii) complaints to MoH and SNEM functionaries would engage the Municipality’s governance and information systems through reports and fines; and iii) communities would recognize an established presence in their neighbourhoods to address their concerns and counteract the cycle of disempowerment, social resentment and queimeimportismo.

\(^{20}\) Information systems infrastructure in Machala and El Oro are very weak, stakeholders have identified a number of areas and issues that would benefit greatly from shared information and improved mobilization of resources. Most often, these identified areas were improved synergy between different entities within the MoH. The problematic of governance, reporting and enforcement of hygiene standards for vacant lots in Machala is a particularly illustrative example of how intersectoral collaboration for improved information sharing could produce innovative strategy to address complex health and social issues without creating redundancy in human resources, bureaucratic process and resident fatigue.
Framed within the context of *Buen Vivir* and Ecuador’s constitution as the model for development, this kind of intersectoral collaboration seems possible. There are, however, significant historical, political and social barriers to intersectoral action for improved governance. Well-established political and legal jurisdiction boundaries will have to be challenged, training of existing MoH, SNEM and health commissioner human resources to work together to enforce by-laws will have to be undertaken, budgets negotiated, authority shared and political fall-out withstood. What seems like a relatively straight-forward issue with perceived “easily-identifiable culprits” (neglectful lot owners and an impotent and uncaring municipality) becomes a complex issue when narrative and socio-political context is explored. Intersectoral spaces and collaboration must be intentionally constructed to address this issue in all of its complexity; the constitutional framework of *Buen Vivir* may provide a long-term vision robust enough to sustain the process if all stakeholder groups, including the community, are invested in addressing this issue in the painstaking way it requires.

### 4.3.4 Summarizing the vignettes

As a story telling style, vignettes are intended as short depictions that provide particularly compelling and vivid examples of larger, harder to articulate dynamics [286]. Vignettes are also considered as incomplete on their own, the details only grow together to join the broader vision when they are layered and presented in the context of those greater dynamics. The three vignettes presented here illuminate three distinct but related facets of the complex problematic of participatory dengue prevention and control in Machala.

The first vignette highlights an emblematic example of how the shortcomings of current evaluation strategies can lead to skewed perceptions of the needs and responses of communities as they pertain to participatory dengue prevention and control strategies. *Quemeimportismo* and paternalism dovetail to shape opinions, perceptions and evaluation strategies that perpetuate the cycle of disempowerment discussed in section 4.1.2.2 whereby community stakeholders
are relegated to the passive role of “recipients”. The example of meeting attendance is particularly telling in that it represents the clear and tempting opportunity for decision-makers, grappling with limited resources, to reduce a complex dynamic to a simplistic, easily digestible quantitative measure. Unfortunately, this succinct illustration is not unique; current evaluation strategies often forego the richer, more complex, and harder to interpret information that contextual, tacit and experiential knowledge provides.

The second vignette explores the development of a new index intended as a means of bringing more of the contextual information regarding socio-economic status into the mainstream evaluation strategies. However, new indices or indicators alone cannot ensure that equity of process, participation, or as it pertains to human health will be improved. In fact, the application of even excellently crafted and sensitive evaluation metrics are subject to the same social, political and cultural dynamics that produce aspects of the harm they were designed to address; this may render them ineffectual or harmful in their use [105]. Therefore, new evaluation tools must be designed and applied with these social dynamics in mind.

The third vignette focuses on the challenges to addressing social determinants of dengue transmission risk within a divided political and governance system. In the opinions of all stakeholder groups involved, vacant lots represent a significant hazard to community health and well being; they also are thought to contribute substantially to dengue transmission risk during the rainy season. Political, social and legal mechanisms exist to govern the clean-up of these foci of infestation, however, in a climate of restricted resources and limited political will, the means to operationalize a practical solution continues to elude authorities and communities alike. The lesson in the case of the vacant lot points toward the intentional construction of intersectoral spaces to address persistent issues that, although not always apparently so, are part of the social determinants of health. At a systems level, this example may also speak to the influence of social
determination of dengue risk in Machala; despite full acknowledgement of a threat to health, policy and power structures impede measures that may directly reduce dengue transmission risk, and in turn, health equity in Machala.

4.4 Results summary: Who and How?
In this chapter I have presented the results of an ethnographically-framed social network mapping and analysis process, including stakeholder analysis and an exploration of social and cultural dynamics that come to bear on the structure and function of the social network as it pertains to participatory dengue prevention and control in Machala, Ecuador. These results address the first specific research question that asks: who are the stakeholders involved in and affected by participatory dengue prevention and control programs in Machala and how do they interact within that context? Six major stakeholder groups have been identified as belonging to the Machala network: community, local government, government functionary, government administrator, researcher and private sector. Varying degrees of collaboration and interaction throughout the network are shaped by dynamics embedded in the social, cultural, political and historical fabric in Machala. Social network mapping and analysis showed a sparse network with a few highly visible actors and inequitable distribution of decision-making power. The overall Machala network comprises three sub-networks that function to manage information and knowledge, deliver services and that pertain to the governance of dengue prevention and control programs through policy.

This chapter also addresses the second specific research question that asks: how do the interactions between stakeholder groups and the perceptions they have of one another affect evaluation, KT and research-to-policy processes? The dynamics of differing health priorities, paternalism/equitable participation, quemeimportismo/social resentment, nepotism/centrism/social justice, marginalization/self-determination and Buen Vivir all affect the way that members of the network interact with one another and with the problematic of dengue fever and participatory prevention and control programs in Machala. In particular, the three illustrative vignettes reveal larger underlying dynamics that suggest, i) there
is indeed a need for new evaluation strategies and tools to facilitate equitable participation and knowledge use for participatory dengue prevention and control in Machala; ii) these tools must be designed and used with a strong emphasis on improving health equity, and supported by the application of an underlying KT model with a strong emphasis on equitable participation; and iii) intersectoral spaces and collaboration should be built to address antagonistic social dynamics as well as particular health issues in order to better leverage resources and improve well-being while reducing redundancy. These results form the basis upon which I will address the third specific research question regarding evaluation tools and KT models in Chapter 5.
Chapter 5 – Results: Participatory Evaluation for Scale-up

The overarching research question of this thesis challenges current knowledge management strategies with the view of improving equitable participation for all stakeholder groups within the context of participatory dengue prevention and control in Machala. The structures, functions and social dynamics affecting the Machala network explored in Chapter 4 provide a comprehensive basis for further considering the notion of equitable participation. Rather than merely regarding the gathering of stakeholders from disparate groups around the same table at strategic times during the research, development or policy-making process as a research item or methodological feature, the frame of social justice and health equity tethers the principle of equitable participation to pervasive antagonistic cultural norms and structural violence. Bringing people “to the table” only fosters equitable participation if the table and the rules of sitting at it do not perpetuate these deep-seated dynamics.

The results presented in this chapter address the third specific research question that asks: Are new tools, strategies and models required to support more equitable evaluation and knowledge translation processes? If so, what do they look like? In section 5.1 the questions of stakeholders and their interactions is revisited with a brief policy-specific stakeholder analysis that builds on the previous chapter and an overview of dengue policy in Machala. The need for new evaluation tools and strategies is addressed through the presentation of the results of the participatory indicator development process (sections 5.2 & 5.3); an array of important indicators is discussed with relation to power, social dynamics and differing definitions of success between stakeholder groups. A new evaluation tool is presented (section 5.4) with considerations for both performance and impact over the short, medium and long term, and its application is discussed in the context of a new KT model (section 5.5) with a
strong emphasis on equitable participation and the construction of intersectoral spaces to address destructive/oppressive social dynamics.

5.1 Context of Dengue Policy in Machala

Dengue prevention and control policy, and participatory dengue prevention particularly, provides a revealing window through which to explore human health as a product of social, cultural and political processes. Evaluation and scale-up, as elements of the research-to-policy process at different levels, must be participatory, iterative and equity-focused in order to challenge the pervasive norms of vertical, paternalistic policy and programming [292]. As discussed in section 2.1 and Chapter 4 of this thesis, dengue prevention and control policy has historically been centered around the use of insecticides to control mosquito vectors dictated by entomological surveillance, epidemiological indices, and to a lesser extent, public pressure in the face of overwhelming mosquito nuisance or dengue outbreaks and epidemics. More recently, dengue prevention and control activities in Machala have been focused on participatory programs focused on mosquito-breeding source elimination and education, but with limited success in terms of sustained, equitable community participation [288].

Implementation and evaluation of a horizontally-oriented program requiring active intersectoral spaces and collaboration within a vertically-oriented macro-system marked by disciplinary silos is difficult and requires an investment of time and capacity building. Prioritization and dedication of limited resources, especially including human resources, should be strategically planned to facilitate bridging disciplinary silos and fomenting equitable collaboration [293]. Identified cultural, social and political dynamics should also inform context-specific strategies for participatory dengue prevention and control in Machala, including the establishment or improvement of intersectoral spaces for collaboration and capacity building [58]. Horizontality and intersectorality are often cited as important for shaping “next steps” or long-term goals and scale-up of local successes with EcoHealth-style or EBS dengue prevention strategies [97, 294, 295]. These recommendations, although crucial to improving policy and
programs, imply a fundamental shift in the organization of established systems that do not possess the flexibility or will to make dramatic, far-reaching and high-level structural changes in a relatively short period of time and based on the recommendations of dengue program evaluation alone [296]. The organizational structure of policy-making systems affects their function, which is inextricably linked to decision-making hierarchy, culture and social norms [297].

Recommending policy options that disregard existing political and social organization diminish the prospects for the uptake of those recommendations and invites significant revisions of those policy options to accommodate current practices and norms [120]. The policy decision-making social network in Machala as it pertains to dengue prevention and control consists of multiple vertical entities and programs clustered around the identified issue of dengue (Section 4.2.2.3). There is a tension, then, between the existing political organization and the motivations of the research described in this thesis, as well as the EBS-Ecuador project, that are to improve intersectoral collaboration and horizontal adoption of elements of dengue prevention policy. In such a context, compromise forced by this tension may result in a “root” policy adopted by the vertical body of the Ministry of Health, with horizontal ties or “runners” adopted by other policy stakeholders in the network. This carries significant implications for intersectoral collaboration and equitable process; however, without a guiding vision of the importance of community-based dengue prevention and no specific policy to govern equitable process, intersectoral spaces may be constrained by existing organizational biases resonant with the socio-cultural dynamics identified in Chapter 4. The example of barriers to improving solid waste removal services discussed with regard to the vacant lots vignette points to the relatively ineffectual “dengue-driven” argument for successfully initiating completely horizontal dengue prevention policy. Solid waste removal affects many different social, health, security, and environmental concerns for neighbourhoods, communities, parishes and the entire urban and peri-urban area of Machala; dengue would be one point on a long list of contributing arguments. The policy
climate in Machala, regardless of disciplinary or hierarchical decision-making body, is marked by high demand on limited resources; competing interests, constraints of related policies and laws, as well as the time-sensitive nature of the policy process within election cycles may all frustrate the research-to-policy process [298].

Using appropriate indicators and evaluation strategies could improve the “horizontality” and uptake of resulting policy recommendations through the creation of policy windows pertaining to social, environmental, and cultural determinants of health [295, 298]. Decision-makers, researchers and other stakeholders involved with the EBS-Ecuador project would play the role of policy entrepreneurs in coordinating communication, knowledge sharing and the coincidence of policy agendas to convene at the orchestrated window [186]. For example, the clean patio and safe containers arm of the EBS-Ecuador project proposed dengue prevention strategy could also be seen as a strategy for the reduction of diarrheal diseases, rat and cockroach infestation, injury and environmental contamination. As well, the dengue elementary school education arm could be seen as part of a larger strategy to improve sanitary education and health literacy from an early age through the promotion of a culture of preventive health rather than curative health. Both arms of the EBS-Ecuador project proposed dengue prevention strategy would support the shift within the Ministry of Health toward a more holistic view of human health that includes non-medical determinants of health, preventive health programs and health literacy. Policy windows and the research-to-policy process, however, depend on the usability or accessibility of produced data and evidence, underscoring the importance of equitable participation for all stakeholders in the indicator development and evaluation processes.

5.1.1 Reflections of policy stakeholder analysis
A stakeholder analysis focused specifically on power, potential and relationships as they relate to the policy process provides some additional insight to the Machala network; the full analysis can be found in Appendix 4.3. Policy decision-
making power is concentrated mainly with the government administrator stakeholder group, and even further with the high-ranking administrators within that group. Although mid and high level administrators from the Ministry of Health, SNEM, Ministry of Education, Ministry of Environment, and the Municipal Government of Machala are interested in and pursue intersectoral collaboration to improve dengue control and prevention programs, there is relatively little interface directly involving these administrators, front-line functionaries, local governments and communities themselves. There is, nevertheless, a perceived opportunity for researchers and universities to bridge this gap with innovative knowledge translation strategies. Interview and focus group responses describe the ideal role of universities and researchers as

1) providing a framework within which other actors can navigate their own interactions
2) facilitating equitable communication and knowledge sharing between stakeholder groups that may be in conflict or have opposing views and goals
3) compiling evidence in a relatively unbiased way to support the pursuit of alternative and innovative solutions to persistent challenges
4) suggesting follow-up and evaluation strategies, platforms and tools to support the achievement of short, medium and long-term objectives for research, program and policy processes

The locally-based Machala Technical University (Universidad Técnica de Machala, UTM) has taken a minor role in the EBS-Ecuador project despite having had a more direct involvement in the pilot projects that led to the establishment of the initiative. With administrative complications at the university that impeded more systematic involvement now resolved, a memorandum of understanding is being pursued between the University of British Columbia, the Simón Bolívar Andean University (Universidad Andina Simón Bolívar, UASB), and UTM to strengthen the relationship between local researchers and other stakeholders in the Machala network. To this point, the university-based
researchers involved in the design, planning, decision-making and evaluation of the research-to-policy process have been from UASB in Quito and UBC in Vancouver. Machalan researchers in the core research group for the EBS-Ecuador project are based within the Ministry of Health, and they primarily function as administrators and decision-makers. The ethnographically-framed social network analysis identified a need for local university-based researchers to build capacity for and to facilitate knowledge gathering, sharing, mobilization and translation processes, as well as helping to shift evaluation and policy-making processes toward more equitable, transparent and inclusive practice. This shift would represent an intentional and conscious change to counteract deep-seated and historically established cultural and social dynamics for which skilled health research capacity is needed; capacity in the form of university-based research actors whose time and mandate are dedicated to transforming the nature of intersectoral spaces in the Machala network.

5.2 Participatory indicator and evaluation matrix development results
Evaluation exists to measure the success or failure (in varying degrees) of an undertaking, assuming that the metrics used fit the appropriate definition of success. The results presented in Chapter 4, as well as the results of the previous section, question whether that current knowledge management and evaluation strategies are adequately inclusive of the diverse kinds of knowledge, priorities and, perhaps, definitions of success held by the stakeholders of the Machala network. Equitable participation for all stakeholder groups, then, should extend to every aspect and iteration of the research, development, KT and research-to-policy processes to respond to the needs and concerns specific to the local context. Relevance to the Machalan context integral to the results in this chapter extends to the evaluation and KT processes through the participatory process that produced the raw criteria for the evaluation tool. The initial matrix of evaluation criteria was generated through the coding and analysis of focus group and interview data combined with ethnographic analysis; specifically, by incorporating the answers to questions 9a through 9d of the key informant interview guide as well as other reference to similar subject matter. Moreover, the
evaluation tool itself was shaped by a participatory design process. I present these results as being particular to the Machalan experience of designing, implementing, evaluating and intending to scale-up participatory dengue prevention and control programs within a social justice and health equity frame.

5.2.1 Evaluation, indicators and concepts of “success”
Evaluation as part of the scaling-up process implies the identification of successful or beneficial elements of projects or programs, optimizing them with respect to available resources and potential impacts, and subsequently implementing them on a larger scale. The concept of scaling-up successful elements is widely accepted, however, without inclusive definitions of success and positive impact, innovation and equitable participation may be sacrificed. Design and application of evaluation tools are often undertaken by experts, administrators and top decision-makers in the absence of participatory processes; as in the case of the EBS-Ecuador project, researchers initially established the gross evaluation categories of cost, efficacy, acceptability and sustainability based on expert opinion. Although intended as a basic guide to sufficiently meet research and government requirements for evaluation, these categories can thus be considered as being imposed on the Machala network by decision-makers of the research process.

To pursue a more comprehensive appreciation of approaches to dengue prevention and control, a preliminary evaluation matrix was developed through ethnographic observation and coding and qualitative analysis of interview and focus group transcripts as discussed section 3.6 of this thesis (Table 9); a full description of the indicators can be found in Appendix 5 of this thesis. The preliminary matrix was established using the designated evaluation scheme framed by the four gross evaluation categories of Cost, Efficacy, Acceptability and Sustainability. Interview and focus group participants were asked to offer definitions, or examples of indicators that could be used to measure or comparatively evaluate two different dengue prevention programs with respect to these four gross categories. Participants repeatedly asked for clarification on how
to answer the questions, the meaning of the four categories themselves and, in some instances, on distinctions between categories. A sense of ambiguity often preceded attempts by participants from all stakeholder groups to assign indicators or concepts to the categories of cost, efficacy, acceptability and sustainability. The ambiguity and hesitation in response was attributed to 1) the perception that the four gross categories are not distinct, they are closely linked and may overlap with some indicators; and 2) the linkages and overlap between categories become more pronounced when considered in the context of day-to-day implementation of programs.

Difficulty in attributing indicators to categories and the pervasive sense of ambiguity raise questions regarding the adequacy of the imposed evaluation framework based on the concepts of cost, efficacy, acceptability and sustainability; and raises the need to develop context-specific and culturally appropriate evaluation tools, strategies and concepts of success. Conventional dengue prevention and control evaluation strategies are produced by current knowledge evaluation schemes and are centered around entomological, epidemiological and economical technical information. The preliminary evaluation matrix resulting from the initial stages of participatory indicator development supplements conventional evaluation indicators with ones produced by the sharing of experiential knowledge from all stakeholder groups.
<table>
<thead>
<tr>
<th>Gross Category</th>
<th>Secondary level indicator</th>
<th>Tertiary level indicator</th>
</tr>
</thead>
</table>
| Cost           | Human Resources           | Health inspectors/promoters  
                             | Vector control personnel   
                             | Doctors and Nurses         |
|                | Transport                 | Ministry of Health trucks and drivers  
                             | Heavy transport trucks and drivers for community clean-ups  
                             | Vector control transport   
                             | Gasoline                  |
|                | Supplies & Equipment      | Insecticides             
                             | Education materials        
                             | Community incentives       
                             | Tank covers               
                             | Snacks for meetings       |
| Efficacy       | Vector indices            | Pupas per person index (PPI) 
                             | % of houses positive for vectors (house index) 
                             | Typing of productive containers |
|                | Community participation   | % of patios clean and organized 
                             | % of covered tanks         
                             | Changes in healthy behaviours |
|                | Epidemiological indices   | Dengue incidence         
                             | Number of people treated   
                             | Frequency and magnitude of outbreaks and epidemics |
| Acceptability  | Stakeholder opinions      | Asking people's opinions one-on-one at people's homes or workplaces 
                             | Communication through recognized leaders 
                             | Meetings                  
                             | Short opinion surveys     |
|                | Participation             | Meeting attendance       
                             | Program activities within the home 
                             | Changes in healthy behaviours |
|                | Integration of program concepts into activities and norms | Family and community-level activities incorporate program concepts |
                             | Rhetoric, language and educational activities incorporate program concepts |
                             | Political will incorporates program concepts |
|                | Human and community well-being | Having adequate provision of basic infrastructure and sanitary services |
                             | Having community ideas and opinions considered and applied in program decision-making processes |
                             | Improvement of the community environment, both built and natural |
Table 9 cont’d– Preliminary evaluation matrix resulting from the participatory indicator development process

<table>
<thead>
<tr>
<th>Gross Category</th>
<th>Secondary level indicator</th>
<th>Tertiary level indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intersectoral coordination</td>
<td>Number of participating stakeholder groups</td>
<td>Frequency of meetings, events and collaborative activities between groups</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Official agreements to collaborate</td>
</tr>
<tr>
<td>Community empowerment</td>
<td>Degree of program ownership within the community</td>
<td>Number of new/active community groups involved in program activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Degree of community inclusion in decision-making processes related to program development, evaluation and implementation</td>
</tr>
<tr>
<td>Program institutionalization</td>
<td>Dedicated financial resources</td>
<td>Implementation of recommended strategies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Constant follow-up and evaluation of program activities and outcomes</td>
</tr>
<tr>
<td>Communication of results</td>
<td>Communication via TV, radio and newspapers</td>
<td>Communication via meetings and presentations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communication via flyers and pamphlets</td>
</tr>
</tbody>
</table>

5.2.2 Paternalism, assumptions and participatory process
A total of 119 respondents were successfully recruited to the participatory indicator development survey; one researcher was unable to complete the survey after initial recruitment. Three respondents were excluded from the final analysis as they were unable to complete the entire survey; two were community respondents and one was a local government respondent.

Overall one-way analysis of the participatory indicator development survey suggest that there is no significant difference between stakeholder groups in the assignation of importance to the indicators of the gross categories in the preliminary evaluation matrix (using Kruskal-Wallis $\chi^2$ tests on 4 df: Cost $p=0.053$; Efficacy $p=0.067$; Acceptability $p=0.23$; Sustainability $p=0.23$). There is a general tendency toward stakeholder agreement that all indicators are important to consider, the mean likert scale response to all survey questions was 4.35 and the mode response was 5. However, multiple comparison analysis reveals that the priorities of the government administrator stakeholder group, as revealed by the way they assigned importance to indicators in the preliminary
matrix, significantly differed from other groups in the gross categories of (Kruskal-Wallis, df=4, α=0.05):

i) Cost, community (p=0.0194), local government (p=0.0134), government functionary (p=0.0077)

ii) Acceptability, local government (p=0.0325), government functionary (p=0.0322)

iii) Sustainability, local government (p=0.0130)

There were no significant differences detected by the multiple comparison analysis for the gross evaluation category of efficacy. Analyses of stakeholder responses to secondary and tertiary level indicator groupings (Tables 10 and 11), however, suggest a more nuanced picture of these significant differences.

Table 10 – Kruskal-Wallis/Wilcoxon analyses with multiple comparisons for summed stakeholder responses to secondary level indicator groups

<table>
<thead>
<tr>
<th>Secondary level indicator</th>
<th>Kruskal-Wallis/Wilcoxon</th>
<th>Multiple comparison (c≤0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>df</td>
<td>prob&gt;ChiSq</td>
</tr>
<tr>
<td>Human resources</td>
<td>4</td>
<td>0.048*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobilization</td>
<td>4</td>
<td>0.015*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplies &amp; Equipment</td>
<td>4</td>
<td>0.036*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entomological Indices</td>
<td>4</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community Participation</td>
<td>4</td>
<td>0.57</td>
</tr>
<tr>
<td>Epidemiological Indices</td>
<td>4</td>
<td>0.70</td>
</tr>
<tr>
<td>Stakeholder Opinions</td>
<td>4</td>
<td>0.048*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation</td>
<td>4</td>
<td>0.14</td>
</tr>
<tr>
<td>Integration of program concepts into activities &amp; norms</td>
<td>4</td>
<td>0.23</td>
</tr>
<tr>
<td>Human and community well-being</td>
<td>4</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intersectoral coordination</td>
<td>4</td>
<td>0.019*</td>
</tr>
<tr>
<td></td>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community empowerment</td>
<td>4</td>
<td>0.32</td>
</tr>
<tr>
<td>Program institutionalization</td>
<td>4</td>
<td>0.22</td>
</tr>
<tr>
<td>Communication of results</td>
<td>4</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Note - GA: Government Administrator, GF: Gov't Functionary, GL: Gov't Local, C: Community, R: Researcher
The gross evaluation category of cost comprises indicators linked to basic program infrastructure and strategy. The secondary categories of human resources, mobilization and supplies and equipment all show significant differences in responses, particularly between government administrators and the other groups. At the tertiary level, significant differences were found for all indicators pertaining to transporting MoH and SNEM personnel to neighbourhoods and for vehicles to support neighbourhood clean-up efforts. There were also significant differences in the way that all stakeholder groups valued the use and provision of insecticides for dengue prevention and control.

<table>
<thead>
<tr>
<th>Tertiary indicator category</th>
<th>Kruskal-Wallis/Wilcoxon</th>
<th>Multiple comparison (α=0.05)</th>
<th>Stakeholder Groups</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>* denotes statistical significance p &lt; .05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctors and Nurses</td>
<td>4</td>
<td>0.052</td>
<td>R</td>
<td>GL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GA</td>
<td>GL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GA</td>
<td>C</td>
</tr>
<tr>
<td>Community Incentives</td>
<td>4</td>
<td>0.45</td>
<td>GA</td>
<td>GL</td>
</tr>
<tr>
<td>Ministry of Health trucks and drivers</td>
<td>4</td>
<td>0.009*</td>
<td>GF</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GA</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GA</td>
<td>GL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GA</td>
<td>C</td>
</tr>
<tr>
<td>Heavy transport trucks and drivers for community clean-ups</td>
<td>4</td>
<td>0.017*</td>
<td>GA</td>
<td>GL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GA</td>
<td>GF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GA</td>
<td>C</td>
</tr>
<tr>
<td>Vector control transport</td>
<td>4</td>
<td>0.025*</td>
<td>GA</td>
<td>GF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GA</td>
<td>C</td>
</tr>
<tr>
<td>Gasoline</td>
<td>4</td>
<td>0.097</td>
<td>GA</td>
<td>GF</td>
</tr>
<tr>
<td>Insecticides</td>
<td>4</td>
<td>&lt;.0001*</td>
<td>R</td>
<td>GL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R</td>
<td>C</td>
</tr>
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<td></td>
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<td>C</td>
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<td></td>
<td>GF</td>
<td>GL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GF</td>
<td>C</td>
</tr>
<tr>
<td>Tank covers and other community-based prevention supplies</td>
<td>4</td>
<td>0.37</td>
<td>R</td>
<td>C</td>
</tr>
<tr>
<td>Snacks for meetings</td>
<td>4</td>
<td>0.064</td>
<td>GF</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GA</td>
<td>GF</td>
</tr>
<tr>
<td>Pupas per person index (PPI)</td>
<td>4</td>
<td>0.26</td>
<td>GA</td>
<td>GF</td>
</tr>
<tr>
<td>% of houses positive for vectors (house index)</td>
<td>4</td>
<td>0.24</td>
<td>GA</td>
<td>GF</td>
</tr>
<tr>
<td>Changes in healthy behaviours</td>
<td>4</td>
<td>0.19</td>
<td>GF</td>
<td>C</td>
</tr>
</tbody>
</table>
Table 11 cont’d – Kruskal-Wallis/Wilcoxon analyses with multiple comparisons for stakeholder responses to tertiary level indicators

<table>
<thead>
<tr>
<th>Tertiary indicator category</th>
<th>Kruskal-Wallis/Wilcoxon</th>
<th>Multiple comparison (α=0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>* denotes statistical significance p &lt; .05</td>
<td>df</td>
<td>prob&gt;ChiSq</td>
</tr>
<tr>
<td>Asking people's opinions one-on-one at people's homes or workplaces</td>
<td>4</td>
<td>0.085</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication through recognized leaders</td>
<td>4</td>
<td>0.058</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short opinion surveys</td>
<td>4</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meeting attendance</td>
<td>4</td>
<td>0.011*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program activities within the home</td>
<td>4</td>
<td>0.074</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family and community-level activities incorporate program concepts</td>
<td>4</td>
<td>0.18</td>
</tr>
<tr>
<td>Having adequate provision of basic infrastructure and sanitary services</td>
<td>4</td>
<td>0.041*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having community ideas and opinions considered and applied in program decision-making processes</td>
<td>4</td>
<td>0.2953</td>
</tr>
<tr>
<td>Improvement of the community environment, both built and natural</td>
<td>4</td>
<td>0.0014*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of participating stakeholder groups</td>
<td>4</td>
<td>0.1048</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of meetings, events and collaborative activities between groups</td>
<td>4</td>
<td>0.048*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Official agreements to collaborate</td>
<td>4</td>
<td>0.18</td>
</tr>
<tr>
<td>Degree of program ownership within the community</td>
<td>4</td>
<td>0.24</td>
</tr>
<tr>
<td>Institutional implementation of recommended strategies</td>
<td>4</td>
<td>0.01*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant follow-up and evaluation of program activities and outcomes</td>
<td>4</td>
<td>0.23</td>
</tr>
<tr>
<td>Communication via flyers and pamphlets</td>
<td>4</td>
<td>0.25</td>
</tr>
</tbody>
</table>

The gross evaluation category of acceptability comprises indicators oriented toward describing community well-being and experience, as well as compliance.

The secondary level indicator group for stakeholder opinions showed significant
difference between government administrator responses and those of other
groups. At the tertiary level, the responses regarding using meeting attendance
as an indicator of program acceptance were significantly different between
government functionaries and other groups. Stakeholder group responses
regarding the indicators for provision of basic services and improvement of the
community environment were also significantly different.

The gross evaluation category of sustainability comprises indicators pertaining to
communication, coordination and uptake of the proposed participatory dengue
prevention program by institutions and communities. The secondary level
indicator group for intersectoral coordination showed significantly different
stakeholder responses between multiple groups. At the tertiary level, indicators
regarding the frequency of intersectoral collaboration activities and institutional
implementation of program recommendations showed significant differences in
stakeholder responses.

Overall, significant differences were observed for indicators that pertained to
activities that directly facilitate the participatory process and to addressing non-
medical determinants of health. Transport of personnel and equipment to and
from communities for meetings, intersectoral collaborative activities, as well as
community clean-up efforts are paramount to equitable community-based
dengue prevention. In addition, institutional implementation of program
recommendations, the provision of basic services and improvement of the
community environment, all address social, environmental and political
determinants of dengue transmission risk. These indicators were generally more
highly valued by communities, local governments and researchers than by
government administrators and government functionaries. This may represent a
rigidity of government actors in visioning practical, effective dengue prevention
strategies that do not conform to convention. Interestingly, the use of insecticides
showed significant differences in the responses between all stakeholder groups;
it was more highly valued by communities and local governments than by
government functionaries, government administrators and researchers. This may be due to the national and international environmental movement to reduce pesticide use influencing researchers, government administrators and functionaries, while the immense influence of nuisance mosquitoes during the rainy season in dengue affected neighbourhoods may be driving community and local government inclinations toward active responses.

The social analysis in Chapter 4 and the differences in stakeholder responses to the indicator development survey illustrate the importance of equitable knowledge sharing and the establishment of intersectoral spaces that facilitate empowered collaboration to address the determinants of dengue transmission risk in Machala. Collaboration and equitable participation imply acceptable, accessible, appropriate and meaningful contribution to all stages of the knowledge-to-policy processes, with particular emphasis on decision-making throughout. To this end, it is important to attempt to understand how communities perceive these processes and their role in them. An investment of time and resources into co-creating and using this knowledge with communities will require a shift in the definition of success for the Machala network, particularly the decision-makers. Rather than focusing solely on conventional impacts and outcomes (i.e. reduced entomological and epidemiological indices), successful or beneficial dengue prevention programs should also consider community empowerment, equitable participation and sustained evaluation-design-implementation cycles as important as well; all of which can be considered as products of emancipatory action research praxis [155, 186, 195].

Responses to the community participation, empowerment and well-being survey echo the findings of Chapter 4; paternalistic programming serves to disempower communities and exclude their ways of being, knowing and participating from conventional dengue prevention strategies (Table 12). The median likert responses show that communities feel their participation in and access to information about dengue prevention and control activities is weak, their
communities have little to no influence over dengue programs and policies, and feel fairly secure and have a fair quality of life in their neighbourhoods.

Table 12 – Median likert responses to the community participation, empowerment and well-being survey

<table>
<thead>
<tr>
<th>Abbreviated question</th>
<th>median response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Participation</strong></td>
<td></td>
</tr>
<tr>
<td>My community participates in activities for dengue prevention and control</td>
<td>2</td>
</tr>
<tr>
<td>We are regularly informed about dengue prevention programs</td>
<td>2</td>
</tr>
<tr>
<td>People in my neighbourhood are consulted before dengue prevention and control decisions are made</td>
<td>2</td>
</tr>
<tr>
<td>Dengue prevention and control decisions include community opinions</td>
<td>2</td>
</tr>
<tr>
<td>We have the opportunity to participate in evaluation of dengue prevention and control strategies</td>
<td>2</td>
</tr>
<tr>
<td><strong>Empowerment</strong></td>
<td></td>
</tr>
<tr>
<td>People in my neighbourhood participate in neighbourhood activities and elections</td>
<td>2</td>
</tr>
<tr>
<td>We have strong opinions about dengue prevention and control programs</td>
<td>2</td>
</tr>
<tr>
<td>We attend meetings and express our opinions truthfully to authorities</td>
<td>2</td>
</tr>
<tr>
<td>We can influence the way that programs and policies are made</td>
<td>1</td>
</tr>
<tr>
<td>We are supportive of one another and concerned with each other's health and security</td>
<td>2</td>
</tr>
<tr>
<td><strong>Well-Being</strong></td>
<td></td>
</tr>
<tr>
<td>I feel safe living in my neighbourhood</td>
<td>4</td>
</tr>
<tr>
<td>I feel that I have access to the services and resources my family needs</td>
<td>3</td>
</tr>
<tr>
<td>I feel proud of my neighbourhood and the way it looks</td>
<td>3</td>
</tr>
<tr>
<td>I feel that my neighbourhood is important to the people that live here</td>
<td>3</td>
</tr>
<tr>
<td>We have a good quality of life in my neighbourhood</td>
<td>3</td>
</tr>
</tbody>
</table>

5.3 Ethnographically-informed analysis of indicator development and stakeholder perceptions

Variations in stakeholder opinions and indicator valuation cannot be considered as separate from the local context within which they are produced. Just as cultural, historical and environmental factors combine to influence social dynamics, they also influence perceptions and opinions. For this reason, cataloguing differences in opinion in a deductive manner, dismantling the points-of-view of groups of people to reflect only their position on individual indicators is contradictory to envisioning evaluation and research-to-policy processes shaped by the local context, the social network and the socio-cultural dynamics that resonate within it. The ethnographically-framed social network analysis should
inform the interpretation of the participatory indicator development survey data and therefore inform the development of the evaluation tool and KT model.

5.3.1 Principal component analysis and social dynamics

As discussed in Chapter 3, PCA simplifies a complex data set by identifying major trends and structural descriptions of those trends. Importantly, PCA offers quantitative descriptions of patterns, trends, and differences for a given dataset; it cannot interpret the meaning of those trends in the larger context of social and political processes. Given that the data for this PCA are opinions and perceptions of stakeholders involved in and engaged with the EBS-Ecuador project and with participatory dengue prevention and control in Machala, PCA provides a mathematical skeleton upon which ethnographic and social network analyses can build a more complete picture. Principal components can be thought of as axes along which variables align according to their Eigen value derived from the dataset; they are defined by the variables that are associated with the extremities of the axes. Variables in this analysis are the proposed indicators, and the axes may be described as the tension between these indicators that arises from prioritization or valuation schemes. Essentially, respondents who prioritized indicators at one extreme of the principal component, generally de-prioritized the indicators at the other extreme. That is, principal components identified within the indicator development data set can be considered descriptive of dynamics that may influence or inform the perceptions and opinions of stakeholder groups and individual participants. Principal component analysis of the participatory indicator development survey data for the tertiary-level indicators revealed that 5 principal components account for over 50% of the variation in the responses of the participants (Table 13; for complete outputs see Appendix 6).
Table 13 – Principal component analysis output for tertiary-level indicators

<table>
<thead>
<tr>
<th>Principal component</th>
<th>Eigenvalue</th>
<th>Percent of variation</th>
<th>Cumulative percent of variation</th>
<th>ChiSquare</th>
<th>DF</th>
<th>Prob&gt;ChiSq</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14.98</td>
<td>32.57</td>
<td>32.57</td>
<td>3140.31</td>
<td>1021.45</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>2</td>
<td>2.567</td>
<td>5.58</td>
<td>38.15</td>
<td>1727.57</td>
<td>1004.6</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>3</td>
<td>2.3552</td>
<td>5.12</td>
<td>43.27</td>
<td>1568.5</td>
<td>964.218</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>4</td>
<td>1.8939</td>
<td>4.12</td>
<td>47.38</td>
<td>1417.57</td>
<td>924.263</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>5</td>
<td>1.649</td>
<td>3.59</td>
<td>50.97</td>
<td>1307.06</td>
<td>884.361</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>6</td>
<td>1.5208</td>
<td>3.31</td>
<td>54.27</td>
<td>1215.71</td>
<td>844.912</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>7</td>
<td>1.4317</td>
<td>3.11</td>
<td>58.15</td>
<td>1131.82</td>
<td>806.063</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>8</td>
<td>1.2846</td>
<td>2.79</td>
<td>60.18</td>
<td>1051.6</td>
<td>768.047</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>9</td>
<td>1.2216</td>
<td>2.66</td>
<td>62.83</td>
<td>982.787</td>
<td>730.707</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>10</td>
<td>1.1551</td>
<td>2.51</td>
<td>65.35</td>
<td>916.077</td>
<td>694.285</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>11</td>
<td>1.1025</td>
<td>2.40</td>
<td>67.74</td>
<td>852.197</td>
<td>658.555</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>12</td>
<td>1.0154</td>
<td>2.21</td>
<td>70.25</td>
<td>789.655</td>
<td>623.692</td>
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</tr>
<tr>
<td>13</td>
<td>0.9643</td>
<td>2.10</td>
<td>72.05</td>
<td>733.363</td>
<td>589.618</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>14</td>
<td>0.9338</td>
<td>2.03</td>
<td>74.08</td>
<td>679.031</td>
<td>556.509</td>
<td>0.0003</td>
</tr>
<tr>
<td>15</td>
<td>0.8137</td>
<td>1.77</td>
<td>75.85</td>
<td>623.939</td>
<td>524.241</td>
<td>0.0017</td>
</tr>
<tr>
<td>16</td>
<td>0.7987</td>
<td>1.74</td>
<td>77.58</td>
<td>581.1</td>
<td>492.815</td>
<td>0.0037</td>
</tr>
<tr>
<td>17</td>
<td>0.7357</td>
<td>1.60</td>
<td>79.18</td>
<td>536.397</td>
<td>462.335</td>
<td>0.0097</td>
</tr>
<tr>
<td>18</td>
<td>0.7018</td>
<td>1.53</td>
<td>80.71</td>
<td>496.775</td>
<td>432.781</td>
<td>0.0179</td>
</tr>
<tr>
<td>19</td>
<td>0.6819</td>
<td>1.48</td>
<td>82.19</td>
<td>458.381</td>
<td>404.107</td>
<td>0.0319</td>
</tr>
<tr>
<td>20</td>
<td>0.6294</td>
<td>1.37</td>
<td>83.56</td>
<td>419.113</td>
<td>376.397</td>
<td>0.0635</td>
</tr>
<tr>
<td>21</td>
<td>0.5988</td>
<td>1.30</td>
<td>84.86</td>
<td>384.122</td>
<td>349.61</td>
<td>0.0986</td>
</tr>
<tr>
<td>22</td>
<td>0.5526</td>
<td>1.20</td>
<td>86.06</td>
<td>350.311</td>
<td>323.792</td>
<td>0.1489</td>
</tr>
<tr>
<td>23</td>
<td>0.5407</td>
<td>1.18</td>
<td>87.24</td>
<td>320.396</td>
<td>298.888</td>
<td>0.1877</td>
</tr>
<tr>
<td>24</td>
<td>0.5147</td>
<td>1.12</td>
<td>88.35</td>
<td>288.974</td>
<td>274.972</td>
<td>0.2691</td>
</tr>
<tr>
<td>25</td>
<td>0.4628</td>
<td>1.01</td>
<td>89.36</td>
<td>258.259</td>
<td>252.066</td>
<td>0.3809</td>
</tr>
<tr>
<td>26</td>
<td>0.4172</td>
<td>0.91</td>
<td>90.27</td>
<td>233.054</td>
<td>230.115</td>
<td>0.4335</td>
</tr>
<tr>
<td>27</td>
<td>0.4107</td>
<td>0.89</td>
<td>91.16</td>
<td>212.72</td>
<td>209.082</td>
<td>0.417</td>
</tr>
<tr>
<td>28</td>
<td>0.3938</td>
<td>0.86</td>
<td>92.02</td>
<td>190.804</td>
<td>189.066</td>
<td>0.4509</td>
</tr>
<tr>
<td>29</td>
<td>0.3652</td>
<td>0.79</td>
<td>92.81</td>
<td>168.924</td>
<td>170.036</td>
<td>0.5097</td>
</tr>
<tr>
<td>30</td>
<td>0.3483</td>
<td>0.76</td>
<td>93.57</td>
<td>149.279</td>
<td>151.978</td>
<td>0.5467</td>
</tr>
</tbody>
</table>

The first principal component accounting for 32.6% of the variation in the dataset shows a uniform distribution of all variables at its positive extremity (Figure 14, a & b). This indicates an overall agreement or trend exhibited by the participating stakeholders toward responding in a similar way to survey questions; recall that the mean response to all survey questions was 4.35 and the mode response was 5. Given that responses were based on a likert scale of 1 to 5, with 4 valuing the indicator in question as “very important” and 5 as “extremely important”, principal component one (PC1) indicates an overarching trend of valuing dengue
prevention indicators as important. Dengue is an important health issue in Machala, and in particular, the stakeholders who participated in the indicator development survey were all involved in the EBS-Ecuador project, however, PC1 cannot automatically be understood to mean that dengue is “extremely important” in larger social context.

Figure 14 – Distribution of variables along the axes of principal components:

a) a graphical representation of principal component one,
b) principal components one and two with the three most distal variables at each extremity,
c) principal components three and four with the three most distal variables at each extremity,
d) principal component five with the three most distal variables at each extremity
Reporting bias may also be present and manifest in two ways: 1) respondents appreciate face-to-face interaction with project staff with whom they are somewhat familiar, so enthusiasm and hospitality may shift responses toward a more “positive” response; 2) respondents believe that their participation in the EBS-Ecuador project is a rare opportunity to affect positive change in participatory dengue prevention programming and through their responses attempt to convey the importance of affecting that positive change. Both dynamics are borne out by the health priorities identified by stakeholders through interviews and focus groups. Although dengue is a prominent concern, there were many other identified health issues that may take precedence over dengue in the absence of a dengue outbreak or epidemic (see discussion in Chapter 4, section 4.1.2).

Principal component one represents an overarching trend or dynamic observed in the way that participants assigned value or importance to the proposed indicators for the evaluation matrix. Without discounting the response bias discussed above, principal component one supports the theory, developed through ethnographic observation and social network analysis and discussed in Chapter 4 of this thesis, that conventional division of stakeholder groups alone do not determine or define opinions, point-of-view or orientation to participatory dengue prevention and control. Instead, participant responses from all conventionally defined stakeholder groups tend to follow a similar pattern, echoing the findings of overall Kruskall-Wallis analysis discussed in section 5.2.2. This challenges the notion of intersectorality as a panacea for facilitating equitable participation; EcoHealth, EBS and KT literature often recommend constructing intersectoral spaces as a means to facilitate equitable KT and research-to-policy processes. Although intersectoral spaces are crucial, without understanding and challenging social, political and cultural dynamics that exist there too, processes and collaboration within these spaces may be as equally frustrated as conventional efforts. If stakeholder group divisions do not determine ways of being, knowing, and working as they are assumed to do, bringing
“diverse” actors together may not result in a diversity of opinion, orientation or priority-setting. Interestingly, PC1 is by far the most dominant trend in the dataset, suggesting that, 1) there may be more consensus within the stakeholder universe than previously considered; 2) interest in improving participatory dengue prevention and control is similar across all identified stakeholder groups; and 3) interest in process evaluation is similar to interest in impact evaluation across all identified stakeholder groups.

Principal component two (PC2) may represent a tension between paternalistic, technocratic dengue prevention activities and facilitating equitable community participation. PC2 shows that respondents who prioritized technical epidemiological measurements of program efficacy and chemical control of mosquitoes, also de-prioritized elements of equitable community participation and community ownership of programs (Figure 14 c, Table 14). This emphasizes two of the findings of the ethnographically-informed social network analysis: 1) established patterns of paternalistic programming and decision-making processes serve to disempower communities and negate their equitable participation; and 2) the valuation bias toward “arms-length” technical indices and quantitative information and against experiential knowledge and lay experience in program design, monitoring, evaluation and policy-making.

Principal component 3 shows that respondents who prioritized assuring availability of gasoline, mobilization of SNEM functionaries to reach neighbourhoods and the importance of medically-trained personnel, de-prioritized measurements of household behaviour change and compliance including the house index (Table 14). This may represent a tension between investing in the physical presence of SNEM functionaries and medical personnel for dengue prevention activities in communities and persistently high dengue indices coupled with a perceived lack of household behaviour change. The mobilization of SNEM functionaries and medical personnel implies an importance attributed to conventional prevention and control efforts as implemented my SNEM and MoH
staff. At the time this survey was undertaken, the implementation of new participatory dengue prevention programming had not yet begun. Conventional activities include insecticide fogging and intradomiciliary spraying, entomological surveys, educational talks and epidemiological investigation of suspected cases and during outbreaks. Most commonly these activities are “top-down” or administered to a community, as ordered by government administrators or triggered by high epidemiological or entomological indices. PC3 emphasizes the social dynamic of *Queméimportismo* identified in Chapter 4; this principal component carries the paternalistic nuance of assignment of this dynamic by a group in a position of authority to another group, often the community.

**Table 14 – Distal tertiary-level indicators and their Eigen values for principal components 2 to 5**

<table>
<thead>
<tr>
<th>Principal Component</th>
<th>Tertiary-level indicator</th>
<th>Eigen value (+)</th>
<th>Tertiary-level indicator</th>
<th>Eigen value (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Frequency of epidemics/outbreaks</td>
<td>0.262</td>
<td>Inclusion of community ideas in decision-making</td>
<td>-0.224</td>
</tr>
<tr>
<td></td>
<td>Insecticides</td>
<td>0.240</td>
<td>Degree of community inclusion</td>
<td>-0.258</td>
</tr>
<tr>
<td></td>
<td>Confirmed dengue cases</td>
<td>0.227</td>
<td>Community ownership of program</td>
<td>-0.329</td>
</tr>
<tr>
<td>3</td>
<td>Gasoline</td>
<td>0.343</td>
<td>Household compliance with program</td>
<td>-0.193</td>
</tr>
<tr>
<td></td>
<td>SNEM Mobilization</td>
<td>0.337</td>
<td>House Index</td>
<td>-0.205</td>
</tr>
<tr>
<td></td>
<td>Doctors &amp; Nurses</td>
<td>0.290</td>
<td>Household behaviour change</td>
<td>-0.233</td>
</tr>
<tr>
<td>4</td>
<td>House Index</td>
<td>0.289</td>
<td>Meeting attendance</td>
<td>-0.235</td>
</tr>
<tr>
<td></td>
<td>Dengue Incidence</td>
<td>0.278</td>
<td>Opinion surveys</td>
<td>-0.285</td>
</tr>
<tr>
<td></td>
<td>MoH Inspectors</td>
<td>0.258</td>
<td>Asking stakeholder opinions through community meetings</td>
<td>-0.336</td>
</tr>
<tr>
<td>5</td>
<td>Communication through media outlets</td>
<td>0.369</td>
<td>Community incentives</td>
<td>-0.243</td>
</tr>
<tr>
<td></td>
<td>Communication through meetings</td>
<td>0.306</td>
<td>Institutional implementation of project results</td>
<td>-0.251</td>
</tr>
<tr>
<td></td>
<td>Communication through pamphlets</td>
<td>0.303</td>
<td>Change in family and community behaviour</td>
<td>-0.262</td>
</tr>
</tbody>
</table>

The fourth principal component may represent the complementary social dynamic of social resentment. PC4 shows that respondents who prioritized the use of the House Index and Dengue incidence, and Ministry of Health Sub-center Inspectors, also de-prioritized attendance at community meetings, asking stakeholder opinions through surveys and at community meetings (Figure 14c, Table 14). This emphasizes the tension between paternalistic dengue prevention programming and a lack of opportunity for meaningful, equitable community
participation in program design, evaluation and the research-to-policy process. Current prevention and control programs rely on the gathering of technical information through MoH personnel, often without incorporating experiential knowledge or qualitative information, like community ideas and opinions, gathered through face-to-face communication at meetings or through surveys. Although community meetings and educational campaigns do play a part in conventional dengue prevention and control programs, these meetings and the information coming out of them alone rarely trigger intervention activities or shape intervention strategies undertaken by MoH personnel. This principal component, then, carries the nuance of social justice and community resistance to paternalistic programming.

Principal component five (PC5) encompasses the connected ideas of communication, messaging and knowledge translation (Figure 14d). The distal indicators of PC5 reveal that respondents who prioritized communication via media outlets, meetings and pamphlets, also de-prioritized providing for community incentives, institutional implementation of project results, and a change in dengue prevention behaviours at the family and community levels (Table 14). Current communication and knowledge-sharing practices (as discussed in section 4.2.4 of this thesis), information and knowledge are generally filtered upward through the hierarchical decision-making networks with decreasing richness and inclusivity. Messaging and directives are then transmitted back down through the network and through media outlets. This communication structure functions largely in the capacity to expedite operational and programmatic decision-making based primarily on quantitative data, while the messaging strategy most often targets increasing community compliance with program directives rather than active and equitable community participation. In this context, PC5 juxtaposes conventional strategies with the growing need for knowledge translation and mobilization strategies designed to increase equitable stakeholder participation in dengue prevention programs, that links institutional and community behaviour change. Given the social and cultural dynamics that
affect and, at times, define intersectoral space and relationships, community incentives can be seen as an act of “good faith” or building a foundation for equitable collaboration\textsuperscript{21}. Incentives can be a contentious issue, and must be negotiated or agreed upon through equitable processes; an incentive that does not respond to the needs of a community will not be an incentive at all. Revisiting the illustrative vignette of vacant lots and dengue control, improved by-law enforcement and elimination of health risks caused by vacant lots would be considered by many to be an excellent incentive that brings the problem of dengue prevention and control to bear within a more holistic vision of health and serves to create positive, functioning intersectoral spaces. In this sense, community incentives can indeed provide a framework within which institutional implementation of recommendations achieved through participatory process (i.e. evidence-based policy and practice) and positive behaviour change at the level of family and community may be facilitated and/or strengthened.

5.3.2 Hierarchical analysis and indicator matrix
Hierarchical clustering allows for further exploration of trends in the indicator development survey data set. Hierarchical clustering analysis is data-driven rather than assumption-driven, and like principal component analysis offers insight into the structure of a data set. Recalling that the participatory indicator development survey data set comprises opinions and perceptions of indicator importance from stakeholders of all identified groups, this analysis enables visualization of similarities and differences in the offered opinions and perceptions. The clustering method used is agglomerative, that is, the dendrogram is built through identified similarities in responses. This follows the interpretivist orientation of this research and of the participatory process, beginning from a basic appreciation of diversity ideas and participants are

\textsuperscript{21} Community incentives in this context should be considered as a broad spectrum of resource and non-resource based ideas, however, they are classically thought of as financial remuneration or the provision of an item free of cost to the community and furnished by the government. Community incentives mentioned by stakeholders from all identified stakeholder groups included a broad spectrum of ideas: financial incentives, community events, contests, scholarship programs, improvement of basic services and infrastructure as well as improvement to public spaces and security.
grouped together based on commonality to reveal linkages and dynamics that affect the research-to-policy and other processes involved in participatory dengue prevention.

Stakeholder clustering groups respondents together based on similarities in how they valued each indicator in the survey. That is, the more similar their “valuation profiles” of the indicators, the more quickly they are grouped into the same stakeholder cluster. Indicator development survey respondents were recruited from five original stakeholder groups (Government Administrators, Government Functionaries, Government Local, Community, Researchers). In keeping with gross original stakeholder universe complexity estimations, the Ward’s hierarchical clustering model was restricted to 5 respondent clusters (Table 15, full output in Appendix 6). Stakeholder clusters generated by the analysis are diverse, meaning that assigned stakeholder groups do not automatically determine similarity in valuation profiles.

Stakeholder clustering of the survey respondents supports the findings of the ethnographically-framed social network, Kruskall-Wallis and the principal component analyses: that conventionally defined stakeholder groups do not determine opinion or perception of participants. Rather, stakeholders within conventionally defined groups bring a multitude of experience, priorities, opinions and perceptions into the social, cultural and political arenas of dengue prevention and control in Machala.

Hierarchical clustering of indicators groups them together based on the similarity of valuation patterns from all respondents. As previously discussed, the gross indicator categories were imposed as expert opinion, which informed the nested structure of the original evaluation matrix. To avoid this bias, only tertiary level indicators were used for the indicator clustering analysis; primary level indicators were excluded to reduce imposed value judgments, and secondary level indicators were excluded to reduce redundancy resulting from the nested matrix
structure (Table 9). The preliminary evaluation matrix grouped indicators according to the four gross evaluation categories (Cost, Efficacy, Acceptability, Sustainability), and the identification of sub-categories and indicator candidates from interview and focus-group transcripts. In the interest of maintaining simplicity of evaluation tools, the Ward’s hierarchical clustering model was restricted to 4 evaluation categories or clusters (Table 16, full output in Appendix 6). Again, the hierarchical clustering of indicators did not reflect conventional or designed groupings. Instead, each new resulting indicator cluster comprised indicators from multiple original gross evaluation categories.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Total n</th>
<th>Composition</th>
<th>n</th>
</tr>
</thead>
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<td>1</td>
<td>37</td>
<td>C 20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>GL 5</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>GF 11</td>
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<td></td>
<td></td>
<td>GA 0</td>
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<tr>
<td></td>
<td></td>
<td>R 1</td>
<td></td>
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<td>2</td>
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<td>Old category</td>
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<tr>
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<td>-----------------------------------------------</td>
<td>--------------</td>
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<td>MoH Inspectors</td>
<td>cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Doctors &amp; Nurses</td>
<td>cost</td>
<td></td>
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<tr>
<td></td>
<td>SNEM Functionaries</td>
<td>cost</td>
<td></td>
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<tr>
<td></td>
<td>SNEM Mobilization</td>
<td>cost</td>
<td></td>
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<tr>
<td></td>
<td>Gasoline</td>
<td>cost</td>
<td></td>
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<tr>
<td></td>
<td>Educational Materials</td>
<td>cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Basic services &amp; sanitary infrastructure</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Continuous follow-up &amp; evaluation</td>
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</tr>
<tr>
<td></td>
<td>Improvement of neighbourhood environment</td>
<td>acceptability</td>
<td></td>
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<tr>
<td></td>
<td>Institutional financial support</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Household control supplies (covers)</td>
<td>cost</td>
<td></td>
</tr>
<tr>
<td><strong>Effectiveness</strong></td>
<td>Dengue incidence</td>
<td>efficacy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Confirmed cases</td>
<td>efficacy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequency of outbreaks/epidemics</td>
<td>efficacy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pupa per person index</td>
<td>efficacy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>House index</td>
<td>efficacy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tidy patio (elimination of vector-breeding sites)</td>
<td>efficacy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% of covered tanks</td>
<td>efficacy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Household behaviour change</td>
<td>acceptability</td>
<td></td>
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<tr>
<td></td>
<td>Community behaviour change</td>
<td>acceptability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Household program activities</td>
<td>efficacy</td>
<td></td>
</tr>
<tr>
<td><strong>Resilience &amp; Responsiveness</strong></td>
<td>MoH mobilization</td>
<td>cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Municipality mobilization</td>
<td>cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inclusion of community ideas in decisions</td>
<td>acceptability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Institutional implement results</td>
<td>sustainability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of participating groups</td>
<td>sustainability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequency of collaborative activities</td>
<td>sustainability</td>
<td></td>
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<tr>
<td></td>
<td>Participation in community meetings</td>
<td>acceptability</td>
<td></td>
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<tr>
<td></td>
<td>Identification of productive containers</td>
<td>efficacy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Establishing intersectoral agreements</td>
<td>sustainability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community inclusion in program development</td>
<td>sustainability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community ownership of program</td>
<td>sustainability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of community groups</td>
<td>acceptability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Face-to-face feedback/opinions</td>
<td>acceptability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change in rhetoric and educational activity</td>
<td>acceptability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feedback through community leaders</td>
<td>acceptability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feedback through community meetings</td>
<td>acceptability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change in political activity</td>
<td>acceptability</td>
<td></td>
</tr>
<tr>
<td><strong>Engagement Facilitators</strong></td>
<td>Communication via media outlets</td>
<td>sustainability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communication via meetings</td>
<td>sustainability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communication via pamphlets</td>
<td>sustainability</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community incentives</td>
<td>cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Snacks for meetings</td>
<td>cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insecticides</td>
<td>cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feedback through short opinion surveys</td>
<td>acceptability</td>
<td></td>
</tr>
</tbody>
</table>
Participatory indicator clusters thus provide new evaluation categories based on stakeholder experiences and opinions, and can be summarized as:

i) Operational sustainability; comprising indicators, originally assigned to cost and sustainability categories, that pertain to the infrastructure required to sustain the function of a participatory dengue prevention and control program. This includes human resource, policy, operational and basic services infrastructure.

ii) Effectiveness; comprising indicators, originally assigned to efficacy and acceptability categories, that pertain to entomological and epidemiological risk reduction through positive behaviour change at the household and community levels.

iii) Resilience & Responsiveness; comprising indicators, originally assigned to cost, efficacy, acceptability and sustainability categories, that pertain to the capacity for a participatory dengue prevention and control program to respond to the changing demands of dengue transmission risk and community needs through equitable, timely evaluation and knowledge translation processes.

iv) Engagement Facilitators; comprising indicators, originally assigned to cost, acceptability and sustainability categories that are the most controversial. The indicators in this cluster are the “least agreed upon” in terms of assigned importance between stakeholder groups, hence, they may force engagement and negotiation in program design and decision-making processes.

The importance of re-defining evaluation criteria and indicator groupings is derivative of the guiding principle of equity and the objective of cultivating an understanding dengue risk and prevention in the a wider, more holistic context incorporating ecological, biological, social, cultural and political determinants. Indicator groupings resulting from the hierarchical cluster analysis provide a participant-driven foundation upon which we can: 1) construct evaluation tools for performance and impact of participatory dengue prevention and control programs
and the research-to-policy process; and 2) formulate a more culturally appropriate and context-specific knowledge translation model. These will be explored in the next section.

5.4 Participatory evaluation tool and its application

The participatory nature of the EBS-Ecuador project proposed dengue prevention program implies an innovation of process as well as innovations in program design, service delivery and policy. An appropriate tool would accommodate evaluation of both process and output. Integrated vector management programs are popular alternatives to conventional dengue control; they also often rely on evidence-based decision-making and can incorporate intersectoral action and community participation. Van den Berg and Takken (2009) propose a performance and impact model of evaluation for IVM strategies that is useful when addressing the complexities of evaluating a participatory program with identified tensions between design and implementation (Figure 15).

![Figure 15 – Health-impact evaluation model for integrated vector management strategies (adapted from van den Berg and Takken 2009) [216]](image)

Evaluating program impacts is conventionally accepted as necessary and relies on more easily measurable, often quantitative and technical, indices and indicators to assess levels of success. Program performance evaluation requires additional and more complex information that provide context, illuminate challenges and successes within the scope of a larger definition of success.
based on cultivating more holistic conceptions of human health and health issues, equitable processes and strengthened intersectoral collaboration [203, 263]. Indicators in the participatory evaluation matrix cover both impact and performance evaluation, and should be applied accordingly in the evaluation of the EBS-Ecuador project and of subsequent scale-up efforts (Figure 16).

As discussed in previous sections, evaluation should not be considered a one-time or endpoint activity, particularly with research-to-action or research-to-policy cycles that are designed to be iterative. The participatory indicator development process identified ideals for performance, equity of process, and sustained positive impact on human quality of life and health; those ideals have inevitably shaped the tool. Adapted from Van den Berg and Takken (2009) there are six evaluation “steps” distributed evenly between performance and impact divisions; the indicators assigned to these divisions also retain their evaluation category identity. The six evaluation steps are as follows:

1) **Context-sensitive problem identification and description** – this group of indicators offers insight into the participatory process employed in the knowledge gathering and syntheses stages that inform program design and form the foundation for the research-to-policy process.

2) **Knowledge sharing and collaboration** – this group of indicators offers insight into the nature of collaborative processes that support the research-to-policy process: degree of intersectorality, participatory praxis and formalized agreements to support collaboration.

3) **Implementation and evaluation** – this group of indicators offers insight into the nature of implementation and evaluation practice: degree of equity in participation, potential for sustained evaluation/refining process, and stakeholder (including institutional, community and political) uptake of program activities and recommendation.
**Note** - Gross evaluation categories are designated as **OS**: operational sustainability, **R&R**: resilience and responsiveness, **EF**: effectiveness, **EN**: engagement facilitators

**Figure 16 – Evaluation tool for participatory dengue prevention and control programs in Machala**
4) **Short-term dengue risk reduction** – this group of indicators offers insight into the capacity to evaluate short-term program impacts and to the degree of impact on dengue risk. These indicators should be measured several times per year to evaluate impact during wet and dry seasons, and as such, require repeated investment of human and economic resources.

5) **Medium-term dengue risk reduction** – this group of indicators offer insight into the capacity to evaluate mid-term program impacts and to the degree of impact on dengue risk. These indicators should be evaluated at least once per year during the wet season and window of highest dengue transmission, and as such, require sustained investment of human and economic resources to support the ongoing gathering and processing of this data.

6) **Long-term dengue risk reduction** – this group of indicators describe processes crucial to sustained dengue transmission risk reduction that are difficult to facilitate and difficult to measure. These should be evaluated at natural junctures of the iterative research-to-action and research-to-policy processes as determined by timelines established through participatory praxis.

Importantly, this tool is meant to guide progress and sequential iterations of improvement and revision to the participatory dengue prevention and control program toward a more culturally, socially and public health appropriate program. Repeated evaluation at early, mid and late junctures in the research-to-action and research-to-policy processes should yield increasingly favourable evaluations. For each indicator there is an implied activity, analysis or outcome; when assessing projects, whole programs or various phases of either, the evaluator should assign value on a “yes/no” basis. For example, if the current phase of the EBS-Ecuador project gathers information regarding the social or cultural context of dengue transmission risk via community meetings and through connections with community groups, the box next to each of those indicators would receive a “check”. If the current phase of the EBS-Ecuador project has not
yet completed the implementation of the proposed participatory dengue prevention and control program in the intervention clusters, there would be no way to measure the impact of the program on entomological or epidemiological indices; thus, the boxes for house index, pupa per person index and percentage of covered tanks would not receive a “check”. These “checks” would then be summed for each “step” providing insight as to the progression of the project or program along the research-to-policy trajectory, for performance vs. impact providing insight into strengths and challenges to achieving established objectives, and overall sums providing a gross comparative metric both for cycle-to-cycle comparison for the same program and between different programs (i.e. participatory vs. conventional programs). Sums per gross evaluation category at the overall level provide insight into general strengths and challenges for each program; these sums should be divided by the total number of indicators in each gross category (operational sustainability=10, resilience and responsiveness=19, effectiveness=9, engagement facilitators=7) to provide insight into culturally and socially relevant bridges and barriers to achieving program objectives. A hypothetical evaluation comparing the conventional program to the EBS-Ecuador project proposed participatory program, and comparing progression stages of the EBS-Ecuador project is outlined in Table 17. For the purposes of demonstration of the tool’s utility, we will assume the following:

a) both the conventional and participatory EBS-Ecuador project proposed dengue prevention and control programs will be successful in reducing dengue vector indices and epidemiological indices

b) the conventional program will stay static over the implementation, evaluation and refinement window of the participatory program

c) cultural, social and political dynamics are not being actively changed through the conventional program

When compared with conventional dengue prevention and control programs, participatory programs regardless of stage are rated higher overall and in virtually every category (Table 17). There is a trend of improvement from the early to late stages of the participatory program, however, not even the late stage EBS-
Ecuador project program would receive a “perfect score”. This is notably because of the long-term processes and goals included in the ideals of an equitable, effective, resilient, responsive and sustainable dengue prevention program: change in political process, establishment of formalized intersectoral agreements, meaningful community incentives, institutional implementation of results and recommendations, community ownership of program, community behaviour change, provision of basic services and sanitary infrastructure, and improvement of the neighbourhood environment are all long-term goals that require sustained and intentional effort. This “perfect score”, and thus the scope of the objectives and ideals set out by the stakeholders involved, will likely not be attainable for many years. Implications of scaling-up the participatory program to include the entire Municipality and beyond provide a particularly illustrative example of this scope when considering the lofty goals of community ownership, provision of basic services and infrastructure and improvement of the neighbourhood environment.

Table 17 – Comparative evaluation outcomes for the EBS-Ecuador project proposed participatory dengue prevention and control program in early and final late stages, and the conventional program

<table>
<thead>
<tr>
<th>Evaluation Step</th>
<th>EBS-Ecuador early</th>
<th>EBS-Ecuador late</th>
<th>Conventional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>5</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Step 2</td>
<td>6</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Step 3</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Step 4</td>
<td>11</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Step 5</td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Step 6</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Program Elements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>17</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>Impact</td>
<td>16</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>Overall</td>
<td>33</td>
<td>38</td>
<td>31</td>
</tr>
<tr>
<td>Gross Category (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operational Sustainability</td>
<td>80</td>
<td>80</td>
<td>70</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>67</td>
<td>89</td>
<td>56</td>
</tr>
<tr>
<td>Response &amp; Resilience</td>
<td>74</td>
<td>84</td>
<td>37</td>
</tr>
<tr>
<td>Engagement Facilitators</td>
<td>71</td>
<td>86</td>
<td>29</td>
</tr>
</tbody>
</table>
This tool is designed for comparative evaluation of programs between iterative implementation/evaluation/refinement cycles and between programs with different designs and objectives. The strengths of this tool are to explore general trends in progress toward already-established objectives, to facilitate the equitable inclusion of all stakeholder groups through improved participatory process, and to establish context-specific and culturally appropriate evaluation strategy. The values generated by this tool should not, however, be interpreted without supporting information regarding specific indicators. For example, the impact indicators regarding entomological and epidemiological indices are scored only on a yes/no basis, meaning that these risk indices are either reduced or not reduced as a result of the program. There is no information included as to the index values themselves; therefore, a substantial decrease in these indices would register the same way as a marginal one. Just as participatory process seeks to integrate with and improve upon already existing programs, this tool is designed to augment existing evaluation strategies and guide cyclic, participatory evaluation praxis.

Because of the specificity of this evaluation tool to the context of dengue in Machala, using this particular tool to evaluate similar EBS or EcoHealth participatory or community-based dengue prevention programs undertaken in other places with different dengue knowledge, attitudes and practices, and different social, cultural, political, environmental and biological determinants would be less illustrative of the tool’s utility than if it was used in the context within which it was created. The innovation of this tool is the process through which it was produced, rather than the tool itself. The biomedical, economic and technocratic roots of knowledge translation theory assume that research products, tools and innovations can be transmitted to new populations to address a variety of issues; the products only require modification to the new context. Principles of emancipatory praxis, community-based action research and social determination of health, all of which inform the research of this thesis, explicitly convey the importance of first understanding, in as organic a way as possible,
the broader contexts of issues before they are defined or described, and
definitely before tools are adapted to address them. The utility of this tool for
other communities, issues and contexts is only possible through sharing
methodology and providing a relevant example of participatory, ethnographically-
framed evaluation strategy designed to improve equity of process and facilitate
meaningful intersectoral collaboration. Importantly, this tool is designed for use
that is heavily informed by ethnographic and social network analysis and guided
by a participatory knowledge translation model. The KT model will be presented
and discussed in the next section.

5.5 Toward equitable participation in dengue policy: Knowledge
translation for emancipatory praxis
Evaluation matrices and indicators will not automatically improve equity of
process and ensure fair and meaningful participation; they are tools to be used
within an environment intentionally co-created to foster equitable partnership with
communities, government, private sector and researchers. These tools can help
to inform the construction of an inclusive, emancipatory environment, but it is
important to understand that it will be slow change done over a period of time by
a group of persistent and thoughtfully engaged actors from all stakeholder
groups. Adapted from the KT process outlined in Graham et al. (2006), I propose
a new model based on participatory process with a focus on equitable community
involvement, emancipatory process and social network mapping as part of the
knowledge gathering process (Figure 17). The Machala model for knowledge
translation seeks to incorporate inclusive ways of working, being and valuing
knowledge in order to transform the research-to-policy process\textsuperscript{22} as it pertains to
participatory dengue prevention and control in Machala.

\textsuperscript{22} The transformation of the research-to-policy process here refers to a breaking down of
knowledge valuation systems that hold research as a validating filter through which knowledge is
passed before engaging KT. As discussed in section 2.4.2, varying degrees of rigour are used to
determine corresponding degrees of value, and to differentiate information, knowledge, research
and evidence along a scale of increasing priority and preference. Under this dynamic, KT is first
engaged through establishing rigour and then transmitting the knowledge/research/evidence. The
Machala model challenges this placing equitable participation as the primary driver for KT and
contextual relevance of varying kinds of knowledge (not just research evidence) as valuable
In summary, the Machala model comprises 7 steps arising from and interacting with a participatory knowledge gathering process (Table 18). Rather than a unidirectional process around the circular pathway of knowledge translation, the Machala model encourages a cycle of knowledge gathering at each step and encourages the pursuit of “fractal-style” KT, where any given step in the KT cycle may in and of itself require a full KT cycle to satisfy equitable process and socially, culturally and politically appropriate responses to identified needs.
Identification of issues or problems should be considered part of the knowledge gathering process that drives the KT cycle.

Table 18 – Comparison of the knowledge translation model outlined by Graham et al. (2006) and the Machala model for knowledge translation

<table>
<thead>
<tr>
<th>KT Model, Graham et al. (2006)</th>
<th>Machala Model for Participatory KT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step</strong></td>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td>Knowledge creation</td>
<td>Process through which major types of knowledge are refined by research to be made more valid useful to healthcare systems.</td>
</tr>
<tr>
<td>Identify problem and review knowledge</td>
<td>Identification of a problem by a group or individual and searching for knowledge or research to address it</td>
</tr>
<tr>
<td>Adapt knowledge to the local context</td>
<td>Decision-making process through which the value, usefulness and appropriateness of particular knowledge to the specific issue, setting and circumstances</td>
</tr>
<tr>
<td>Assess barriers to knowledge use</td>
<td>Implementers assess for potential barriers that may impede knowledge uptake as well as uptake facilitators</td>
</tr>
<tr>
<td>Select, tailor and implement interventions</td>
<td>Planning and executing interventions to facilitate and promote awareness and implementation of the knowledge</td>
</tr>
</tbody>
</table>
### Table 18 cont’d – Comparison of the knowledge translation model outlined by Graham et al. (2006) and the Machala model

<table>
<thead>
<tr>
<th>KT Model, Graham et al. (2006)</th>
<th>Implication</th>
<th>Machala Model for Participatory KT</th>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Monitor knowledge use</strong></td>
<td>Defining and measuring knowledge use</td>
<td>Monitoring the changes in knowledge, understanding or attitudes, changes in behaviours or practice, or manipulation of knowledge to achieve a given output or goal.</td>
<td><strong>Implement and refine interventions and strategies</strong></td>
</tr>
<tr>
<td><strong>Evaluate outcomes</strong></td>
<td>Evaluate the impact of knowledge use or application</td>
<td>Determining the success of an intervention based solely on the measurable impacts of the intended knowledge use</td>
<td><strong>Participatory evaluation of performance and impact</strong></td>
</tr>
<tr>
<td><strong>Sustain knowledge use</strong></td>
<td>Determining the sustainability of the knowledge use</td>
<td>Assessing barriers to knowledge sustainability, tailoring interventions to the barriers, ongoing monitoring and impact evaluation</td>
<td><strong>Sustain intersectoral collaboration</strong></td>
</tr>
</tbody>
</table>

Equitable participation in the research-to-action and research-to-policy process requires acknowledgement of the social, cultural and political dynamics that shape intersectoral spaces through personal interactions of collaborators and groups, their perceptions of one another and of the issues and how their experiences, knowledge and goals are perceived and valued by one another [263]. The Machala model’s main objective is to support the building of equitable communities of practice that may work to identify, describe and address complex issues within the principal frame of context-specific, community-based emancipatory action research. The KT model outlined by Graham et al. (2006) was designed for improving care, service delivery and patient health.
outcomes in the context of the Canadian primary care system, and thus uses language and theory to build a method of transmitting created knowledge from producers to users to provoke a desired effect [263, 299]. The concept of knowledge creation implies that knowledge, in a usable and valid form, does not exist without first filtering through a research-driven process with a proprietary aspect. This research-validated knowledge is then manipulated to target specific knowledge users to impact identified problems. Although this model has been useful for improving patient outcomes and primary care, indeed it has increasingly important implications for evidence-based practice, this model does not align well with participatory, community-based or emancipatory processes with marginalized populations and complex public health issues like the tropical neglected diseases [300]. The paternalistic nature of the Graham KT model would likely serve to exacerbate the social dynamics identified in Chapter 4, and complicate intersectoral collaboration. The Machala model of KT provides space for the acknowledgment of these dynamics and encourages equitable intersectoral collaboration to address identified issues, while experientially working toward changing destructive and disempowering dynamics.

5.6 Results summary: Evaluation, power and tools

The results presented in this chapter addresses the second specific research question by examining some of the ways that the social and cultural dynamics identified in Chapter 4 affect evaluation, KT and research-to-policy processes. In particular, the policy stakeholder analysis explores the nuances of stakeholder relationships with one another and with the issue of participatory dengue prevention and control that arise when considering evaluation and scale-up. Power dynamics and knowledge valuation schemes dictate definitions of success and shape evaluation tools and processes that are exclusionary to experiential and tacit knowledge and that perpetuate narrow conceptions of health, benefit and dengue transmission risk. Intersectoral collaboration with equitable community participation should shape new tools and processes that include social determinants of health and that address the oppressive aspects of social determination of health and structurally violent systems.
Interestingly, opinions regarding evaluation criteria did not significantly differ by stakeholder group overall. Despite some finer-scale differences in valuation of indicators between groups, the results presented in this chapter suggest that social and cultural dynamics, as well as history and narrative of place, may be far more important factors in determining both stakeholder priorities and the character of intersectoral spaces.

This chapter also applies the research findings to address research question 3, and present what a more equity-sensitive evaluation and knowledge translation tool and process could look like. Evaluation tools should address both impact and process-related performance and must be used with an underlying KT strategy that employs a strong emphasis on equitable participation and health equity. These findings emphatically point to the deep need for change in underlying institutional power structures and research-to-policy processes, without which new evaluation tools will likely not "make sense" or result in improved policy, programs and well-being of communities.
Chapter 6 – Discussion & Conclusions

This chapter reflects on the findings discussed in Chapters 4 and 5 of this thesis from the perspective of the study’s overarching research question as well as its generalizability. Through the lens of incongruous worldviews (section 6.1), the implications of the results for the EBS-Ecuador project, anticipated scale-up and policy recommendation processes, and larger systems are discussed (section 6.2) with particular focus on the intersection of social determination and KT (section 6.2.2). Strengths, weaknesses and next steps are discussed in section 6.3.

6.1 Worldview, social determination and KT

Although the research presented in this thesis is specific to the local context of Machala, it carries implications for community-based research and development on a larger scale. While the particulars of the descriptions of social dynamics, stakeholder analyses, social network map and analysis, evaluation tool and recommended strategy are all constructed within and for Machala; the underlying methodologies, processes and overarching goals are relevant to various experiences within other local, regional, national and global contexts. Indeed, this study was conceived to address a specific local challenge as it manifests through social determination, including macro-, mid- and local-level forces; but it may serve as a template for other issues in other contexts. Social determination of health and knowledge translation, two of the mechanisms central to the design and investigation of the research questions of this thesis, can be seen to lie at the interface of incongruous worldviews as they pertain to human health, well-being and security (Figure 18). The concept of worldview is useful to interpreting the results of this thesis in that it encompasses both the concrete and abstract elements of physical, social, cultural and political attributes that shape ways of being, working, learning, collaborating and relating to “others” [34]. In terms of research and bridging paradigmatic, disciplinary and sectoral gaps, worldview also includes hermeneutic, ontological and epistemological dimensions [35]. In
the following sections I will use the conceptual model of incongruous worldviews to explore the implications of the results presented in thesis as they pertain to participatory dengue prevention and control, as well as pertinent elements of determining systems.

Conventional dengue prevention and control programs, currently the dominant strategies institutionalized within the Ministry of Health and SNEM, is firmly rooted in the reductionist, positivist, biomedical worldview of public health and health care systems. These systems rely on technocratic “expert” knowledge, usually quantitative, to identify, understand, interpret and act upon human health issues. This narrower worldview frequently dominates the wider, more holistic interpretivist worldview, more often held by “non-experts” and/ or “experts” who embrace alternative disciplinary or epistemological orientations, that rely on experiential and tacit knowledge, usually more qualitative in nature, to identify, understand, interpret and act upon the same issues. Invoking the macro-level power structures and the policy mechanisms that distribute power, control and agency within those structures, social determination is linked to worldview. For example, neoliberalism and its extractive economic policies, is a worldview that social and critical epidemiology directly challenges through the inquiry and investigation in the pursuit of improved health equity. Importantly, the holistic
interpretivist worldview also incorporates knowledge and ways of understanding from the narrower positivist worldview; this acknowledgment of the value of both kinds of knowledge and ways of cultivating understanding and meaning is essential to the holism of this worldview. However, there are areas where focus on certain observations in the absence of other considerations can produce misleading conclusions or inappropriate emphases.

Worldviews are much more than knowledge use and valuation profiles, they are constructions based on our experiences, both collective and individual, that incorporate our various kinds of knowledge, assumptions and perceptions, the ways that we understand the world to operate, and our individual and/or collective place in our world [66]. In themselves, worldviews are a way of seeing and understanding the world, as well as a primordial determinant of the way that we take in, interpret and act upon knowledge and information; particularly new information that may or may not “fit” with our individual and collective constructs. As we endeavour to navigate both familiar and unfamiliar issues, we look to gather information to help us mobilize, make decisions and solve problems. When faced with unfamiliar and broad fields of knowledge, we strongly incorporate what is recognizable, familiar and valuable, while only weakly (if at all) incorporating what is unrecognizable, unfamiliar and invalid [301, 302].

Asymmetry in the relative power of worldviews adds another dimension: dominant worldviews more often determine what is recognizable, valuable and valid leading to the perpetuation of dominant dynamics, sometimes even in the face of concerted efforts to challenge them [301, 303]. Here again, the frame of incongruous worldviews, including the character of their interface, deepens the understanding of the tension between social determination and KT. Ideologies inextricably linked to the dominant power structure inevitably influence value systems, especially those that carry direct implications for policy and decision-making within the institutions belonging to the same structure. In the case of complex human health issues, and indeed dengue, these power structures are
dominated by reductionist, biomedically-oriented and technocratic approaches to evaluation. Consequently, KT models and strategies should be designed, applied and revised to improve the equitable use of knowledge that my otherwise be rendered as invisible, invalid, or unimportant to health policy and programming decision-making processes.

In this way, the perhaps unfamiliar results presented in this thesis both reflect and interrogate this tension between worldviews at the local, mid and macro-levels: understanding that social determination is produced by dominant worldviews at the global level that indeed, through complex mechanisms, affect human health, well-being and security in the local context. Specific to the conclusions drawn in the following sections, I will situate the tensions, social dynamics, of incongruous worldviews meeting within the context of dengue transmission risk, participatory dengue prevention and control and global health research.

6.2 Implications of results

The results reported in this thesis address the overall research question regarding the ways in which current knowledge management strategies limit equitable participation in participatory dengue prevention and control programs and identifying opportunities for change through addressing three specific research questions:

1) Who are the stakeholders involved in and affected by participatory dengue prevention and control programs in Machala and how do they interact within that context?

2) How do the interactions between stakeholder groups and the perceptions they have of one another affect evaluation, knowledge translation and research-to-policy processes?

3) Are new tools, strategies and models required to support more equitable evaluation and knowledge translation processes? If so, what do they look like?
I will explore the implications of these results for the contexts of the EBS-Ecuador project, the broader anticipated policy recommendation and scale-up process, and for the critical engagement with the even broader systems of influence and structural violence within them.

To this point, the challenge of integrating equity concerns is central to the concept of knowledge translation itself; especially as the concept has been developed and promoted by the Canadian Institutes of Health Research. Focused lines of enquiry, themselves assumed to have validity by experts, into how KT has been integrated into areas such as systematic reviews of effectiveness [304], evaluation [303] or overall achievement of impact [216, 305] nonetheless remain more or less dedicated to the notions that KT is most useful on the implementation or operationalization of “high-quality” knowledge (evidence); and that KT is a process designed to target end users of knowledge to produce effect [306, 307].

Current and emerging literature regarding evaluation-specific KT and the prospects of building KT-informed evaluation strategy, tools and policy continues to point out the need for improved dialogue between disparate stakeholders; increased awareness and consideration of how dominant discourses and practices shape the indicator development and selection process; a more fundamental inclusion of social determinants of health; and the need to broaden the focus of evaluation strategies to include longitudinal evaluation of process, performance and impact [306, 308]. Although many international-level and global KT, indicator development, and evaluation studies still rely on conventional hierarchical valuation of knowledge [305, 309], concerted efforts to rely on contextually-specific and relevant knowledge for these processes is gaining in popularity. There is an identified need for more systematic ways of engaging with local-level knowledge during the scale-up and policy processes [310], however, significant advances in health equity through participatory decision-making have been seen for many different issues, in many different contexts.
In the specific context of dengue, the recent push toward EBS research has lead to the popularization of new indicators (PPI and focus on most productive container types); these indicators are often oriented to the prevailing *modus operandi* using technical data, either entomological or epidemiological in nature, to target tailored interventions at communities with high levels of dengue transmission risk [62, 147, 313], leaving a knowledge gap with respect to social determinants [87, 119].

### 6.2.1 Social dynamics and the Machala network

Cultural, social and political dynamics are crucial to knowledge translation and decision-making processes regarding the understanding and addressing of complexity; both the EcoHealth and Eco-Bio-Social approaches explicitly emphasize the importance of regarding dengue and dengue transmission risk as the product of ecological, biological, and social that are inextricably linked to human health [31, 120, 296, 314]. Participatory and community-based dengue prevention and control research often appropriates the language of social determinants of health, and restricts its scope to anthropogenic modification of the environment considered within the frame of epidemiological or entomological dengue risk (including but not limited to housing conditions, water-related human behaviours, program compliance, land-use). Increasing focus on social determination of health, neglected diseases and “the bottom billion” have widened the view of social determinants of health and begun to shift the frame from a technocratic, biomedical approach to one of justice, social production of health and health as a human right [119, 143, 219]. Rather than relying solely on population-level evidence that links social determinants to epidemiological and entomological dengue transmission risk indicators, evidence for improving dengue prevention and control policy and programs must also rely on local, context-specific evidence that describes the processes through which these determinants affect and interact with the health of particular groups of people [102]. That is, in the case of participatory and community-based dengue prevention and control in Machala, KT models and the research-to-policy process ought to be conceived of and constructed from the theoretical frame of
challenging these oppressive dynamics to promote equity, rather than merely from the position of creating intersectoral space to bring stakeholder groups together. Without the frame of challenging these dynamics, intersectoral spaces will be restricted in the same ways as conventional dengue prevention and control programs, and similar challenges to equity, collaboration and sustained partnership will abide.

Evaluation, follow-up, program responsiveness and resilience, as well as intersectoral collaboration were major challenges identified by the ethnographically-framed social analysis in Chapter 4. Communities, local governments and government functionaries repeatedly expressed frustration with the seeming futility of their participation in efforts to identify alternatives and improve services, as often resulting programs are not changed and identified problems or issues persist. The policy and program decision-making process was also repeatedly identified as a “black box” or a participation bottleneck through which experiences, evidence and knowledge are filtered and subsequently lose their richness and innovative qualities. In the context of the EBS-Ecuador project and the political and social demands for improved participatory and community-based dengue prevention programs in Machala, opening the evaluation and decision-making processes to a larger stakeholder body and with an inclusive knowledge valuation scheme may serve to diffuse the “black box” effect and challenge prevailing oppressive dynamics.

The anticipated scaling-up of the EBS-Ecuador project may present a timely and significant opportunity to bridge the incongruous worldviews of conventional reductionist public health and epidemiology, and more holistic community-based critical epidemiology and social determination. Situating the social dynamics of differing health priorities, paternalism/equitable participation, quemeimportismo/social resentment, nepotism/centrism/social justice, marginalization/self-determination and Buen Vivir as local manifestations of and/or factors related to the dysfunctional relationship between a dominant
(reductionist) and subordinate (holistic) worldview, challenges the fundamental notion that dengue is an issue that belongs solely under the umbrella of public health. In fact, the persistence of dengue is reinforced by oppressive power structures, exclusionary knowledge valuation schemes, paternalistic health programming and service delivery, inequitable distribution of resources and access to services, and global-level economic policy (IMF structural adjustment policies in Ecuador), and should be considered and addressed with this depth of understanding and awareness.

Understanding that there are identified needs to expedite the research-to-policy, program design, implementation and evaluation processes, emphasizes the importance of developing tools that build on current practices toward equitable collaboration. The program implementation-evaluation-design cycle is well suited to incorporating equity-building praxis as it is iterative and directly influences the degree to which programs respond to community-identified needs and the evidence-based policy (research-to-policy) process. Focusing on supplementing conventional impact indicators with participatory impact indicators and process evaluation may promote transparency in the conventional “black box” evaluation process and encourage a sustained iterative evaluation process. Evaluation tools and processes established through equitable participation are key to promoting equitable KT, as opposed to judicious KT informed by prevailing cultural, social and political dynamics, and emancipatory, participatory research-to-policy processes.

6.2.2 Participatory evaluation tool and KT model
The proposed participatory evaluation tool and KT model are designed to be of practical use, to orient evaluation and KT processes toward equitable participation and health equity, and to call attention to how the larger systems of determination of health influence the issues of dengue transmission risk and participatory dengue prevention and control in Machala. The evaluation tool and the KT model are also designed to exist within a dialectic relationship between macro- to local-level forces (social determination of health), knowledge valuation
schemes, social determinants of health, individual health and well-being and the systems that govern and produce them (Figure 19). Engaging these larger systems through the lens of participatory program (and project) evaluation has the potential to expose routinely ignored or unrecognized systematic production of harm during the policy-making process. Research-to-policy processes in public health are often rooted in evidence-based policy theory dealing in narrowly defined concepts of what constitutes valid evidence; usually quantitative, biomedically oriented knowledge. The concepts and definition should be broadened to include analyses of how systems of social determination influence national and local-level social, cultural and political dynamics that impact human health and well-being, the identification and addressing of health issues, and local health programs and policy. Without critical reflection based on equitable participation and with an overarching goal of improving health equity, these systems will remain unexamined, unchallenged and unaddressed, particularly within local contexts. The most insidious quality of structural violence and the negative dimensions of social determination of health is that it is not always recognizable; their ubiquity and permeation of the social, political and cultural systems we live in has normalized them to the point of invisibility [59].
To this end, the KT model and the evaluation tool are designed for use together in the context of a participatory, or more ideally a community-based, project or program. The evaluation tool, designed to facilitate the evaluation of both impact and process, should be iterative with KT cycles continuous through the research-to-policy process (or during anticipated scale-up). In this way, the co-creation of a relational worldview is made possible. As shown in Figure 19, KT cycles interface with systems of social determination through a participatory evaluation step.

Conventionally, dominant reductionist-positivist worldviews work through macro-level forces that empower decision-makers to impose an exclusionary knowledge valuation scheme through which varied and rich knowledge becomes distilled.
evidence to support policies that perpetuate disempowering health interventions and programming. The objective of using an equitable KT process to support participatory evaluation is to change the knowledge valuation interface to incorporate knowledge generated through the holistic-interpretivist worldview, and to challenge current policy-making mechanisms. Equitable intersectoral spaces may be created and supported through emphasizing a strong focus on equitable participation further into the evaluation and policy-making process through broader forms of valid evidence, the physical and political presence of all stakeholders throughout the process, and challenging oppressive and inequitable power structures.

“The control of dengue and vector-borne disease have always been managed through end effects, and through the behaviour-change of its victims. I mean, this continues to be important, I don’t deny that you have to work locally and with the affected families, with the families at high exposure risk. I think, in fact, that the project we are developing now in Machala is absolutely along these lines. There is no doubt that with relatively simple measures, dengue can be an interesting excuse to open a discussion on infectious diseases in general because it is so visible; there is the [discarded] can, there is the larva. For other diseases that are more hidden and do not have such an obvious epidemiological cycle, dengue can be a great teacher. It can provide us with a deeper understanding provided that we do not engage in a victim-blaming process, right? In other words, the family is accused for not understanding that they have to remove a tire, and nothing is said about that industry or the fact that the city does nothing to help deal with the overproduction of tires in our society. So, I think that dengue, because of the relative clarity of its social determination, can be a great teacher and it should be taken as a formative first step toward a fuller awareness of health.” - Key informant interview

Intersectoral spaces and collaboration are often proposed in participatory action research discourse as solutions for addressing complex health issues, with main challenges to successful collaboration being jargon, language, paradigmatic bias and different or misaligned goals [49, 315]. This focus on the additive and multiplicative effects of collaboration across disciplines and vertically-siloed sectors often fails to recognize the underlying dysfunction of clashing worldviews. Collaborative strategy must focus on building equitable relationships at all levels.
in order to create robust and functional spaces and relationships that make the co-creation of relational worldviews possible; worldviews where knowledge is created through partnerships, where inquiry focuses on the generation of a participative dialectic, and where outputs are co-created [316, 317].

In the specific context of participatory dengue prevention and control in Machala, this evaluation tool and KT model are proposed for both the comparative evaluation of prevention and control programs through the EBS-Ecuador project, and to be applied in the anticipated stages of policy recommendation and scaling up to full Municipal coverage of successful program elements. Taking a systems view of the opportunities that the scale-up stages represent, allows the multi-disciplinary and multi-sectoral research team (including community, local government and government functionary stakeholders) to challenge the tensions between macrosectoral silos (ministry vs. municipality, municipality vs. water utility), address harmful social dynamics (paternalism, quemeimportismo, social resentment, etc.) and confront the exclusionary knowledge valuation scheme with robust evidence based on qualitative, experiential and tacit knowledge. Institutionalization of research results often requires policy; support and interest often wane without an agent binding practice to governance systems. Thus, the policy recommendations made by the EBS-Ecuador project should include consideration for overall participatory process in public health program design, implementation and evaluation, for equitable participation for all affected and interested stakeholder groups in the respective policy-making processes, as well as making specific recommendations based on the results of the comparative evaluation of the dengue prevention and control programs.

6.2.3 Barriers to equitable participation in global health research
As a study in the field of global health, this research is situated within multiple institutional and paradigmatic biases at many different levels. The same determining forces affecting participatory dengue prevention and control in Machala discussed in previous sections also affect global health research and development at the macro-level. Inequitable distribution of power and resources,
as well as biased knowledge valuation schemes permeate the funding, reporting and publishing structures at the global level. The case of the EBS-Ecuador project is that it is one of six countries participating in a multi-centre randomized-controlled cluster study to classify the ecological, biological and social risk factors for dengue transmission and promote innovative prevention and control responses to those factors. It is a three-year study with a total budget of $300,000 funded, evaluated and administered by a partnership between the WHO/World Bank/UNICEF/UNDP Special Programme for Research and Training on Tropical Diseases based in Geneva, Switzerland, and the International Development Research Centre based in Ottawa, Canada. Although there are researchers and experts from dengue-affected countries heavily engaged in the research, they do not belong to the group of decision-makers who determine the overall research agenda through funding opportunities, or timelines through funding agency budget and reporting requirements. For this reason, I argue that this research should be designated as participatory, rather than community-based; considerations of the 20 neighbourhoods in Machala participating in the EBS-Ecuador project did not directly influence the primary research questions, overall study design or timelines.

This multi-country TDR/IDRC-funded project is based on North-South research collaboration, as well as South-South partnerships. Asymmetric power relationships in the EBS-Ecuador project exist within both of these interactions:

i) research agendas, total funds, timelines, reporting cycles and requirements, data management styles as well as some research outputs and products are dictated by the WHO-TDR administrators in collaboration with IDRC partners; they also possess the ability to discontinue funding through yearly-renewable technical service agreements after each annual cycle, although this is highly unlikely.

ii) within Ecuador, the Universidad Andina Simón Bolívar (UASB) in Quito holds the decision-making power for the project and carries out all financial administration and official reporting back to WHO-TDR and
IDRC; there is a close partnership in these activities with the University of British Columbia (UBC) in Canada, in part because the working language for international reporting is English, and in part because of a long-standing relationship addressing health challenges in Ecuador using EcoHealth-style research.

iii) Machala is the site of all community-researcher relationship building, data collection, on-the-ground research activities, intervention implementation, and data entry. Some preliminary evaluation is also done here, but the final evaluation and more sophisticated analyses are carried out at UASB or UBC. Project coordination and research activities are coordinated jointly by a permanent coordinator at the Machala site, and a half-time graduate student coordinator based at UBC with field visits to the Machala site.

The decision-making, economic, knowledge valuation and reporting power is concentrated in geographic places and administrative structures that do interact to varying degrees with the community in the local Machala context; not at all (TDR-IDRC), marginally (UBC), and to a limited extent (UASB). The majority of the work and the richest experience of the ecological, biological and social determinants of dengue transmission risk in Machala is concentrated within entities that have relatively little decision-making power in the research process (neighbourhoods, SNEM, MoH); a direct reflection of inequitable participation and paternalism within global health research systems.

Definitions of community and participation are particularly vulnerable to these power structures. At the global level, community may be defined as experts and leaders who represent large groups of people encompassing a huge social, cultural, demographic, economic and political diversity. As discussed at length in Chapter 4, communities and their elected or chosen representatives do not always share the same priorities or experiences. Key informants alone, such as government administrators and local governments, should not be relied upon to
convey the experiences, concerns and lived realities of the communities they represent. By the nature of their position as “apart from” or “working in” communities, the experiences of experts, administrators, functionaries and authoritative representatives may actually be more representative of the systems of influence that marginalize communities [10, 192]. Geographic, cultural and social distance as well as language and inequitable power sharing are all barriers to participatory process and to self-determination in the overall research process.

6.3 Study strengths and challenges
The strength of this study lies in the examination of the KT process as a function of human interaction rather than of transmission or application of “good” knowledge. In examining KT from this perspective, it provides insights that are consistent with the urging of Davison and the National Collaborating Centre for Determinants of Health (2013) for public health researchers, practitioners, and governance stakeholders to re-engage with KT as a methodology to develop more robust equity-focused models based on: 1) identifying equity as a goal of the model, 2) strong stakeholder involvement, 3) prioritizing multisectoral engagement, 4) drawing knowledge from multiple sources, 5) recognizing the importance of contextual factors, and 6) are centered around a proactive or problem-solving approach [318]. Particularly in the context of community-based and/or participatory health interventions (of which dengue prevention and control provides a vivid example), the process through which KT considers different perspectives, values and ways of knowing from a diversity of stakeholders are relevant to the kind and quality of policy generated through research and inquiry to improve health equity. This study pushes the KT agenda further toward considering knowledge as the product of cultural and social interaction both between stakeholder groups, and between human beings and their political, social, environmental and cultural surroundings. Understanding knowledge as inextricably linked to process, rather than assuming that knowledge itself is static and uncontestable, implies that the critical examination of KT strategies at micro-, meso-, and macro-levels may have significant impact on improving health equity through more equitable collaboration.
As well, due to the specificity of this study to the Machalan context, it should provide a robust model and strategy to support the scale-up for the EBS-Ecuador project in the short-term; and may carry longer-term implications for the establishment and maintenance of equitable intersectoral spaces locally, regionally and nationally. This study is timely in the sense that innovative approaches to controlling and preventing dengue, and indeed vector-borne disease in general, have recently been gaining more intense political attention and scrutiny in Ecuador. There is interest to incorporate Cuban innovations, such as biolarvicide use and active community participation, in a more systematic way through the programs and policies of the National Vector-borne Disease Control Service (SNEM) and the Ministry of Health. Still in the early stages of planning and testing pilots at local levels, this evaluation tool and KT model could be applied to redefine definitions of success for vector-borne disease programs, and may provide an explicit platform for mandating new kinds and areas of collaboration for problem solving in program development and scale-up.

The utility and applicability of the methodology, tool and KT model outlined in this thesis may be aided by their central focus on social dynamics. Although the tools themselves are decidedly specific to the context of dengue in Machala, the social dynamics outlined in Chapter 4 exist primordially to the work done as part of the EBS-Ecuador project. That is, these social dynamics, and social determination, influence much further reaching health issues than dengue or vector-borne disease. The influence of these dynamics on access to water, access to political process, neighbourhood insecurity, access to services, injury and animal infestation are all apparent even within the peripheral considerations of this thesis.

The main challenge of the evaluation tool and KT model presented in this dissertation is that, by design, they have yet to be implemented and tested. The timeliness of this study, at the juncture of implementation and evaluation for the
EBS-Ecuador project to begin in November 2013, limits the scope of this work to development of practical decision aids rather than a proven model for decision making. This limitation is entirely appropriate in the context of the methodology and theoretical framing of the work; developments after all are done in collaboration with as many stakeholders as possible, building on the momentum of progress attained through as equitable a participation as is possible. Until that progress has reached the point (expected in November 2013) that raw data, including entomological indices, epidemiological indices, survey data, and further meetings, are available to analyze and evaluate using the tool and KT model, there can to be no expectation of validation and refining. Further to this, the temporal specificity of this study, in terms of policy windows, actively participating stakeholders, and public and political will, may reduce its generalizability to other programs and/or health issues in earlier or later stages of address. The evaluation criteria and restructured evaluation categories may also be of a level of specificity so as to complicate direct transfer of the evaluation tool for use in improving programs for other identified health issues. Regardless, the underlying principles and methodologies described herein can be of use in a wide variety of contexts, and the KT model should be relatively ready to be applied in other areas.

An important consideration should be made regarding the life and orientation of the EBS-Ecuador project when envisioning utility and applicability of the results of this study. This work was supported by external funding from the Special Programme for Research and Training on Tropical Diseases (TDR), the International Development Research Centre (IDRC), and the Canadian Institutes for Health Research (CIHR), with specific reference to building on such concepts and approaches as EcoHealth and Knowledge Translation; all of which facilitate input from actors and institutions outside of Ecuador. As discussed in previous chapters, Machala is marked by patchy infrastructure; this includes human and economic resources as well. Without increased buy-in from actors already “on the payroll”, the economic and human infrastructure required to carry through
work on this scale may be lacking. Funding for the EBS-Ecuador project will terminate in June 2014, and while research team members, committed collaborators and communities are invested in the project; there is a clear sentiment that without an institutional champion, the advances made to this point may be delayed, stayed or lost. As the tool and model presented here is unrefined, there will be a need to invest human capital (and with that economic support) into ensuring they are appropriately useful and applicable in the Machalan context and beyond. Examination of factors affecting the sustainability of applying this model is therefore especially warranted as a subject of further research – as is consideration of the feasibility of applying it to different contexts.

6.4 Conclusions and next steps
The EBS-Ecuador project aims to implement, evaluate and make recommendations for the scale-up of a participatory dengue prevention and control program in Machala. Acknowledging that there are challenges to these and other processes involved, this thesis focused on the challenges that arise through the knowledge management strategies currently employed by the information, service provision and policy systems that manage dengue prevention and control. Specifically designated within the social analysis arm of the project, the results and discussion presented herein have focused primarily on evaluation and KT processes with an emphasis on improving health equity.

The crux of the arguments in this work hinges on the connection between KT, evaluation and social determination. Oppressive and disempowering macro-level dynamics influence local-level knowledge valuation schemes, social dynamics, social determinants and participatory processes. Within the constitutional frame of Buen Vivir, including a strong emphasis on equity, justice, participation and well-being, enacting a linked KT/evaluation process may provide opportunities to change the nature of intersectoral spaces from those in which incongruous worldviews clash in a climate of asymmetric power distribution, to those in which partnerships build relational worldviews and participative dialectics. The development of a long vision for addressing dengue is also required in Machala.
Collaborative efforts should converge on the provision of basic services, piped water, roads and sanitary infrastructure, rather than primarily focusing on community behaviour change and entomological indices. An even larger view would include framing long-term strategies within social determination, urging the questions: What are the local, provincial, national and international policies that affect dengue transmission risk in Machala? Are there economic, agricultural, land-use, industrial or other policy domains that come to bear on the determination of dengue and related health issues in Machala and El Oro? How are institutional, governmental and research agendas contributing to the perpetuation of dengue transmission risk through intervention, inadvertent pressures and political effect?

The next steps of this work are to apply the evaluation tool and KT model in the evaluation process for the EBS-Ecuador project, and in turn to evaluate their usefulness as supportive mechanisms to equitable process. Further research is needed to more fully understand the roots of the social dynamics identified here and to explore the depth and breadth of their impact in the research, implementation, evaluation, KT and scale-up processes. In particular reference to the anticipated policy recommendation and scale-up process for the EBS-Ecuador project, the creation of a map that combines stakeholder analyses and social network structure (human capacity) with a visualization of the issues inherent to participatory dengue prevention and control (resources, systems, social dynamics, persistent indices), as well as the current and anticipated challenges (barriers to equitable participation, existing antagonistic policies, clashing worldviews) to facilitate intersectoral action in the Machalan context.
References


World Health Organization Special Programme for Research and Training in Tropical Diseases.


Appendix 1 – Excerpted EBS-Ecuador original project proposal

Meeting capacity-building and scaling-up challenges to sustainably prevent and control dengue in Machala, Ecuador

J. Breilh, J. Spiegel, E. Beltrán et al. (2009) [285]

Project Summary
This project applies an integrated community-based approach to prevent and control dengue in a vulnerable endemic setting and analyzes its implementation in comparison with the current reactive insecticide based program to investigate the effectiveness and feasibility of scaling up an ecosystem approach amid a resurgence of dengue in Latin America and the Caribbean. A comprehensive intervention effectiveness evaluation protocol is refined and applied in a region of recent unplanned urban and peri-urban expansion (in Machala, El Oro Province, Ecuador) with particular attention to information system needs for monitoring implementation and transforming presently existing vector control programs in affected areas.

4.1 Problem Statement:
Dengue is a major public health problem in Ecuador; the diverse array of contributing factors and the lack of intersectoral organization within governance systems only exacerbate it. Ecuador has identified all four serotypes of Dengue (DEN I-IV) within its borders and the vector, Aedes aegypti, is distributed throughout the tropical, subtropical regions of the country as well as all of its islands. Moreover, there is poor understanding of the relationships between socioeconomic factors and Dengue virus transmission; education, sanitary household and personal practices, poverty and deficiency of basic public
services are not seen as integral parts of the determinants for how, where and in which populations dengue disease will occur. Vector control programs in Ecuador, including Dengue control, are based on the use of insecticide. Despite heavy reliance on these chemical interventions, the present vector control strategies have not succeeded in maintaining vector indices or populations below the levels required to eliminate Dengue transmission. Because these chemical-centric government-mandated, top-down, vertical programs have been the sole solution to Dengue available to communities, dependence on the state and on chemicals has been created. Out of this disempowerment and ineffectiveness of insecticide-based programs, a strong demand has developed for new community-based and integrated approaches to Dengue management. Much of the demand has been centered in the province of El Oro in southern Ecuador, a province marked by traditionally high Aedes indices.

The province of El Oro is located on the Pacific coast at the southeast border shared with Peru and with a high incidence of dengue. A high proportion of the population is urban (72%), and while the main means of production is agriculture (banana, cacao, coffee), marine aquaculture (shrimp, fish), agro-industry, cattle ranching and commerce, 41.4% of the population lives at or below the poverty line. Machala is the capital of the province with a population of approximately 300,000 inhabitants, with a large peri-urban community characterized by unplanned urbanization due to both internal migration and to immigration from Peru. Machala has an altitude of four meters above sea level and a temperature range between 26 and 35°C, highly desirable conditions for thriving vector populations.

Communities in Machala have been vocal about the need for alternative vector control and dengue prevention strategies, prompting research by epidemiologists, public health officials, vector control officials and members of the Universidad Técnica de Machala faculty to explore and pilot new prevention efforts based on the eco-bio-social paradigm or the ecosystems approach to
human health (Eco-Health) which views human health as a product of and determining force on the ecosystems that people live and work in. These projects were initiated under a capacity-building eco-health program led by this project’s Principal Investigators from the Universidad Andina Simon Bolivar (Breilh) and University of British Columbia (Spiegel). These pilot strategies included school-aged education campaigns, participatory community efforts to eliminate vector breeding containers and the reduced use of insecticide. Each of these interventions resulted in reduced Aedes indices and high community acceptability; however, these pilots were on a small scale and did not have the financial and human resources to implement on a larger scale or along a larger timeline. As a result of these pilots Machalan communities, policy-makers, vector control practitioners, public health officials and educators hold the consensus that education plays a fundamental role in vector control and, more importantly, that a greater shared knowledge base leads both individual and collective action toward Dengue prevention.

Despite increased recognition of the need for integrated community-based interventions focused on vector breeding site reduction, community education and improved domestic water storage and use, there persists a fundamental challenge of how (e.g. what techniques, designs, methods, indicators, evaluation approach) to best scale up effective interventions. To strengthen abilities for achieving sustainable dengue prevention and control in a dengue endemic area, we propose to pilot and evaluate an innovative integrated community-based approach, combining the three previous pilots into one program to promote intersectoral cooperation, and to examine the feasibility of transforming presently existing vector control programs in affected areas.

4.3 Analytic Conceptual Framework:
Applying the ecosystem approach to understanding human health (that interdisciplinarily considers biological, ecological and social system factors with particular regard to equity and participation) used by team members in previous
research efforts, we will examine factors that are associated with the presence of the *Aedes aegypti* mosquito and dengue infection in humans to especially focus on the factors whereby prevention and control can be most effectively and sustainably pursued. In examining this, we will critically adapt and apply evaluation frameworks through participatory action research methods that are especially well developed in public health contexts. Applying this orientation, we will adapt the conceptual model developed through the TDR/IDRC “Towards *Improved Dengue and Chagas Disease Control*...” proposal development process to more explicitly explore how eco-health interventions can be conducted and evaluated, represented in through the DPSEEA Framework (Kjellstrom & Corvalan 1995; Spiegel et al. 2001) developed by the World Health Organization to consider how interventions can be organized and evaluated. Using these conceptual frameworks as a guide, the project will address the following key research questions:

**Indicator Thresholds**
1. What vector density levels exist at specific points in time related to the potential dengue transmission period, i.e., before and shortly after the rainy season?

**Key Associations**
What household and community factors are correlated with vector density? Which ecological factors, including climate, the availability, infestation and quality of breeding sites, and feeding opportunities affect vector density? What social factors, including population dynamics, public and vector control policies, public service delivery (water supply, waste management), community attitudes and household practices etc) are related to the ecological situation?

**Prevention and Control Effectiveness**
5. What factors affect the actual performance of processes (public services) relevant to dengue prevention and control, including vector control, water supply and waste management?
4.4 Research Objectives:

**Overall objective:**
To better understand the effectiveness and feasibility of applying an integrated eco-health approach to dengue prevention and control in dengue endemic urban and per-urban setting marked by infrastructural weaknesses

**Specific objectives:**
Phase 1: Situational Analysis
1.1 To describe the ecosystem, vector ecology, social-behavioural context, control policies and stakeholders as well as program activities in the study area using qualitative and quantitative research methods.
1.2 To analyze the association of ecological, biological and social factors with Dengue vector density (the main dependent variable estimated by pupal indices as proxy measure).
1.3 To identify key factors which can be modified by public health and behavioural interventions

Phase 2: Intervention and Evaluation Analysis
2.1 To implement two control strategies each within their own treatment area within the study area:
   i) a community-based dengue prevention strategy developed from the interventions identified in 1.3; and
   ii) the existing reactive insecticide-based vertical government strategy.
2.2 To compare the two Dengue management/control strategies and evaluate them for feasibility, acceptability, cost and efficacy.
2.3 To make evidence-based policy recommendations for implementing a feasible, cost-effective, acceptable and effective Dengue control/management program in the city of Machala, El Oro, Ecuador.
2.4 To assess and map out strategies to scale-up and implement successful interventions from the civic level in Machala to the provincial level in El Oro, Ecuador.
4.6 Methodology:

a) Research design:

Our study uses a pre post intervention design with a concurrent control group covering the entire urban area of Machala with repeated measures at two points in time, rainy and dry seasons. To support our study design the city will be divided into two similar areas in terms of population, social strata and Dengue vector density, our main outcome variable. We will use one half of the city as the control area and the other half as the intervention area; the intervention area will be randomly assigned (e.g. coin flip). The sampling design will be a two-stage sampling with stratification. In stage 1, smaller geographical areas defined by a grid system comprising a similar number of city blocks each will be randomly selected; the selection of these areas will be proportional to the size of each of two homogeneous strata defined by the presence or absence of basic municipal services. In stage 2, households will be randomly selected from those areas.

While the study is essentially a “cluster randomized trial”, we have chosen not to define it as such so that we can keep the control and intervention areas quite separate, thereby minimizing the cross contamination likely to occur with an airborne vector in contiguous areas. A more detailed sampling strategy including sample size will be described below. The “control” area will essentially continue with its current vector control program, while the intervention area will receive a new vector control program as described under Phase 2 of our study.

Phase 1 of the study is a situational analysis of the eco-bio-social context of Dengue transmission in Machala, El Oro, Ecuador. This situational analysis, the descriptive stage of the project, will incorporate existing data describing the ecosystem, human and vector populations as well as gather new information through cross-sectional entomological and household surveys, social network analysis and stakeholder analysis. These information gathering tools will combine qualitative and quantitative research methods to assess the problem of Dengue in Machala within known strata of access to public services. There will
be two rounds of information gathering in Phase 1 of the project, one for the rainy season and one for the dry season and the same households selected in Phase 1 will be followed throughout Phase 2.

Phase 2 of the study will build directly on the data gathered and the conclusions reached during Phase 1 of the project. A community-based Dengue control and management strategy will be designed and implemented using a fully participatory approach and the evidence generated in Phase 1. This prevention-centric community-based intervention strategy will be implemented in half the city of Machala, the other half continuing to rely on the responsive insecticide-based intervention already in place. These two strategies will be compared and contrasted in terms of feasibility, acceptability, cost and efficacy by re-administering the surveys and questionnaires in each of the seasons of Phase 2. Policy recommendations will be made for improving and innovating Dengue and vector control strategies at the civic level based on the evidence generated by Phase 1 and 2 of the project. A plan for scaling-up and implementing the program at the provincial level will also be considered in the concluding phase of the study.

This project is informed by the Cuban example of integrated dengue surveillance and control, particularly with regard to the intersectoral cooperation that has made the Cuban example so successful, and was the subject of a pilot study conducted by one of our project co-PI's with involvement of several team members. Intersectoral action requires an interdisciplinary approach to solving problems, developing strategy, sharing of information and resources and their development and a multi-disciplinary evaluation of interventions. Our team consists of entomologists, biologists, social scientists, epidemiologists, public health officials, policy scholars, information technology (IT) specialists, network analysts, statisticians, vector control officials and community-based action research and participatory methodologists.
b) Methods:

Re: Objective 1.1 To describe the ecosystem, vector ecology, social-behavioural context, stakeholders, control policies and control program activities in the study area, we will apply a variety of qualitative and quantitative research methods.

Existing data from civic government, the health zone and vector control department will be used to establish basic geographic, climatological, land use and eco-social dynamics, urbanization and infrastructure information for the city of Machala. Presently available GIS maps of Machala will be overlayed with this basic information and reconciled with habitat and urbanization information from satellite imagery; more specific information will be gathered through a cluster background survey and observational instruments at the cluster level.

Network and stakeholder analyses will provide further insight into the social dynamics within communities affected by Dengue, how these communities interact with one another and with public health, governmental and vector control agencies and how current vector control programs and policies are functioning (and/or are perceived to be functioning) within these communities. Network and stakeholder analyses will be done by an identification of stakeholders by experts (e.g., key agencies working within the community, government staff, community leaders etc.); by self-selection (e.g. following an invitation to stakeholders to come forward for community meetings), through identification by other stakeholders using focus groups, snowball sampling, semi-structured interviews and communications network analyses at the institutional level; and by using written records and population data by using oral or written accounts of major events. Stakeholder personification will help to profile stakeholders using characteristics such as gender, age, power, interests, positions, ethnicity and residence and other more complex characteristics that relate to the dengue and/or vector control "problem".
Once different stakeholder groups have been identified and described, their specific interests and positions will be profiled to elucidate stakeholders' positions according to relative power, interests, and legitimacy to conduct meetings of invited key stakeholders. Once stakeholders have been identified and profiled, the dengue "problem" can be described, identified and situated in its local eco-social context. As part of the stakeholder consultations, the problem assessment exercise will employ the DPSEEA (Driving Forces-Pressure-State-Exposure-Effect-Action) model technique that we have applied successfully in various intervention studies in Ecuador and Cuba, with a time analysis to help understand how the dengue/vector control "problem" evolved over time over time.

The analysis of vector control programs, policy and activity will specifically include a policy analysis and an assessment of program functioning. For the policy analysis, a case study on current vector control efforts will be conducted by a member of the team not directly involved in program administration, preferably by a policy analyst. The case study will be based on document review and key informant interviews and should address policy and well as current vector control practice.

Our policy analysis will build on the direct involvement of the responsible agencies in the study itself by assessing a variety of relevant factors: national health policy dengue/vector control policy documents, guidelines and observed practices; level of prioritization of vector borne disease control within the context of other health issues; contextual relation of the vector control policy within the larger national vector-borne disease control policy, the extent to which existing policy has been translated into strategies and plans of action; national budget for the various vector borne diseases and the level of external donor support for the diseases and vector control; how national, regional/provincial and district vector control programs are directly able to access funds allotted to them, and if so how this is done; Place and structure of vector control: location of the vector control
department or unit within the Ministry of Health and in relation to other disease control programmes (e.g. Community Health, IMCI, MCH and other clinical programs); and how the vector control department or unit relates to the environmental health programs; current and approved organigrams; how vector control operations are organized at the national, regional/provincial, district and sub-district levels (e.g. whether or not vector control is run as discrete single disease programs; whether they are run as vertical programs or otherwise; to what degree the responsibility and decision making authorities, as well as technical support, are decentralized); status of waste management and urban planning.

The situational analysis on current control practice will carefully document staffing levels and program functioning, and include consideration of the number and level of training for vector control personnel at the national, regional/provincial and district levels; vector control efforts currently being carried out sporadically and/or routinely; history of the vector control efforts; core functions of these domains by different levels; current human resources; number of staff by category; education/training background; work roles (what are workers supposed to do?); and work performance (what are workers actually doing?).

Technological advancements over the past few years have allowed surveillance data to not only be collected but also be plotted into sharable high quality mapping systems (GIS). This approach allows specialized data collection systems to submit data to an accurate globally acceptable GIS mapping system, for analysis, reporting, dissemination, and improved data visibility. (Lozano-Fuentes et al 2008) The technique involves the collaboration of two systems: the GIS mapping system (i.e. Google Earth), and the GIS data collection system. The GIS data collection system is typically a custom made computer based system (i.e. webpage) or device in which a person may enter their surveillance details and have them plotted into the GIS mapping system by use of one of the
GIS standards. We will track the current availability and capacities for recording and tracking such data to provide decision-support information.

The situational analysis will be undertaken by a research team as described in the budget justification. The team will be comprised of SNEM staff, supervisors and technologists and student training positions from UTM. The field teams or “brigadas” will do an entomological survey, an environmental survey, and a combined household and knowledge, attitudes and practices survey at each of the 1000 houses in the 10 eco-health treatment clusters as well as in each of the 1000 houses in the 10 current prevention program clusters once per season; two seasons exist in Ecuador – the rainy season from March/April to September/October and the dry season from September/October to March/April.

A yearly dengue prevention information calendar will be given to each of the participating households in the eco-health cluster at the time of the first annual round of surveys to initiate community engagement and education. Calendars will not be given to the households in the conventional treatment study area. At the time the calendar is given the information in the calendar regarding household dengue prevention measures will be explained to the all members present in participating household. At the time of each home visit (both within the eco-health intervention area and the conventional treatment area) a small satchel of the larvicide Abate™ will be given to effectively control tanks holding water for washing and household chores.

**Re: Objective 1.2 To analyze the association of ecological, biological and social factors with Dengue vector density (the main dependent variable estimated by pupal indices as proxy measure).**

Entomological and household surveys will be used to gather information describing specific vector densities within selected areas and to estimate vector densities in the surrounding environs. Entomological surveys will measure vector
densities using the pupae per person index (PPI), pupae per hectare index (PHI) and the Breteau index (BI).

Building on the survey instruments used by some team members in recent case-control study of factors associated with the presence of *Aedes aegypti* foci in Central Havana, Cuba, and instruments used in pilot studies conducted in Machala, we will refine and use household survey questionnaires to gather information on the stated knowledge attitudes and practices (KAP) of residents in the cluster areas with regards to water management and environmental risk factors for Dengue transmission. We will apply the Theory of Planned Behaviour (Ajzen, 1991) to account for the impact of the intention to change the vector control behaviour. In addition to KAP we will include items to address behaviour with respect to water management and environmental risk factors for Dengue.

**Re: Objective 1.3 To identify, through a participatory process, key factors which can be modified by public health and behavioural interventions appropriate to the ecosystem under study.**

This research objective will depend entirely upon the data gathered using the techniques in objectives 1.1 & 1.2, and the results of the analyses in objective 1.2.

The situational analysis in the intervention area will be refined through the establishment of community working groups in the “intervention” clusters, as in the intervention design these units are to become “driving forces” of the community involvement and intersectoral action fundamental to the intervention itself. The eco-health intervention cluster community working groups will be engaged to disseminate results from both the eco-health intervention area and the conventional treatment area. Community working groups will also be assembled in the conventional treatment clusters but the purpose of those
groups is to recruit participants and disseminate conventional treatment area data only.

**Phase 2: Intervention and Evaluation Analysis**

**Re: Objective 2.1** To implement two vector control/dengue prevention strategies each within their own treatment area within the study universe:

i) a community-based participatory eco-health (eco-bio-social) dengue prevention strategy developed from the interventions identified in 1.3;

This eco-health intervention will be modeled on the three feasibility studies undertaken as Masters projects at the Universidad Tecnica de Machala in 2007-2008. If the situational analysis supports the methodology it will be executed as follows:

A school-based dengue prevention education project will be implemented in up to 2 classrooms in 50 schools in the eco-health treatment area of the study universe. Based on the data collected in Phase 1, workbooks will be made for 100 classrooms of 30 students with information aimed at promoting the clean patio and safe water storage campaigns and to empower students to work both at home and with neighbours to reduce pupa per person indices (PPI) in the neighbourhood. Teachers will be given classroom teaching supplies and will receive training immediately following community meetings in their cluster. The school-based education program curriculum will be spaced out over a two-month period following the first seasonal data collection effort. The workbook information will be again reviewed over a one-month period following the second seasonal data collection effort.

A clean patio safe water storage campaign will be launched through community workshops targeting neighbourhood women’s associations. Educational information will be given out to attendees and supplies will be provided to improve the water storage equipment and behaviour. Supplies will consist of one large metal oil-drum style tank, cement to line the tank, paint to cover the outside
of the tank and label it with the letters SNEM (as part of community awareness), a plastic sheet to cover the mouth of the tank and a wooden lid to seal the tank. These community meetings and the educational information will reflect the information given and explained in the calendar and in the school workbooks.

ii) and the existing reactive insecticide-based vertical government strategy. This strategy will remain unaltered from the current/conventional vector control strategy implemented in the whole of El Oro presently. This strategy relies on epidemiological information collected by the ministry of health through hospital records of incident dengue cases in Machala. The location of the cases is obtained and a “focalizacion” team is dispatched to inspect the premises for immature *Ae. aegypti* and collect any present, to talk with the members of the household regarding household dengue prevention techniques and to spray the inside and outside of the house as well as any vegetation and building surfaces within 100 m of the incident dengue case. Spraying is done with a gas-powered backpack sprayer and in extreme cases, the area is fogged with vehicle mounted foggers; the insecticide used is deltamethrine. Small bags of the larvicide Abate™ are also given out in the visited households to put in tanks containing water used for washing and household chores. Brigadas (field teams) are then dispatched in the following days to survey the neighbourhood surrounding the dengue case for the presence of immature *Ae. aegypti*.

**Re: Objective 2.2** To compare the two Dengue prevention/control strategies and evaluate them for feasibility, acceptability, cost and efficacy:

The data collected in Phase 1 will provide a baseline with which to compare the efficacy of the newly implemented community-based eco-health intervention.

Using pupae per person (PPI), pupae per hectare (PPHa) and Breteau (BI) indices, we will compare pre-intervention data to post-intervention data in both the Eco-health intervention area and the conventional program area. The
difference in these indices will serve as a measure of how effective each intervention is at reducing vector populations in the different treatment areas.

Cost analysis will also be done for each of the two programs. Analysis of cost per household covered (CPH), cost per year (CPY) of the programs, and estimated future annual costs (FAC) of the programs will be compared. Cost analysis associated with the clinical management of dengue cases in each treatment area may also be done to examine the further-reaching costs of not effectively preventing dengue disease.

Feasibility and acceptability of each program will be assessed through the household questionnaires and surveys, and through semi-structured stakeholder interviews and focus groups. The semi-structured interviews and focus groups will involve members from all stakeholder groups (i.e. community, government, university, vector control personnel, public health officials, schools and teachers).

**Re: Objective 2.3** To make evidence-based policy recommendations for implementing a feasible, cost-effective, acceptable and effective Dengue control/management program in the city of Machala, El Oro, Ecuador.

This phase of the project will be done toward the end of year 3 of the project. The recommendations will depend entirely on the data and information gathered through years 1 and 2 of the study. The policy recommendations will be established in a participatory way involving members from all stakeholder groups and will include a policy- decision maker.

**Re: Objective 2.4** To assess and map out strategies to scale-up and implement successful interventions from the civic level in Machala to the provincial level in El Oro, Ecuador.
The methods in this stage will depend entirely upon the information gathered and the processes outlined in the preceding phases and years of the project. The scale-up strategy will be developed in a participatory way involving members from all stakeholder groups and will include at least one policy decision-maker for the city of Machala and one for the Province of El Oro. The scale-up strategy will include criteria necessary for implementing the desired (i.e. most effective, cost-effective, feasible and acceptable intervention as determined by the project) dengue prevention/control strategy at the civic level, how those criteria translate to the provincial level, special concerns for implementing control strategies in different communities with unique cultural and social considerations (i.e. indigenous communities, vulnerable populations), and a projection of the financial resources, human resources, organizational structure and public works infrastructure requirements for implementation of the prevention/control strategy. Moreover, it will contain a map of organizations involved in vector control/dengue prevention at the civic and provincial level identifying crucial intersectoral spaces and partnerships required to implement and scale-up the desired program. Information system needs and the feasibility of design options will be explicitly introduced for consideration.

c) Sampling strategy
Sampling Design:
A two-stage sampling design will be used, as is summarized by Figure 2 appendix.

Stage 1. The first step is to get a satellite image and/or map of the study universe. To follow up on a proposed strategy for an accessible information system, we will use Google Earth for this purpose. (Lozano-Fuentes et al 2008)
The sampling strategy for the GIS user can be undertaken by using Arc View and generating a base map of city blocks, residential areas, roadways, public buildings, water bodies, constructional sites, park, gardens etc. On this map, grid cells of known square meters (or number of city blocks) will be constructed as
spatial sampling units for the first sampling stage. Selection of grids will be allocated proportionally to the size of previously defined serviced and not serviced areas.

The following grids will be excluded from the sampling (Exclusion criteria for grid quadrants according to satellite images):
1. No or very few visible houses (except for cemeteries which should be included)
2. Expected grid size exceeds 10 ha due to dispersed houses (unlikely to occur in an urban area like Machala)
3. Large public buildings, factories and industrial complexes should not exceed 25% of the grid area

Stage 2. Households will be selected in equal number from within stage one areas. The method of selection is as follows: Starting from the lower left corner of the selected grid, go 2 blocks to the right and then in a 90° angle “upwards” until the required number of households is reached in this grid. Should the grid not have sufficient households, the adjacent households in the next grid will be included to complete the sample size.

Exclusion criteria of households:
1. Majority of households/premises are permanently closed
2. Majority of households closed during daytime (owners are absent after repeated attempts)
3. Abandoned private areas (tierras baldias) which are not accessible (however, any attempt should be made to get access)

Inclusion criteria:
in cemeteries only a sub-sample (through systematic sampling) of tombs will be taken with a total of 100 tombs
In multi-storey houses of more than 4 floors: in each floor 1 family will be selected systematically and only the « first- floor family » can declare the common patio in the household interview.

Sample size:
Our sample size is dependent
a) on feasibility considerations (what is possible to do in the context and budget of this research),
b) on the statistical assumption of the impact of our intervention.

Based on this and on similar studies on other jurisdictions, it was found to be feasible to include 10 grids with 100 households per grid, in each of the intervention and control areas. This will give a total sample size of 2000 households. Using PPI as the outcome measure and assuming a PPI value of .4, and an expected reduction of 75% after intervention the power of estimation at a 5% level with this sample size is larger than 90%. This will comfortably cover possible non-responses.
Figure 2 - Sampling design and strategy

**Stage 1: Cluster selection**
- Exclusion criteria for grids
- Division of City into 2 Study Areas
- Random designation of where intervention will take place
- Stratification by municipal service provision
- Random selection of clusters

**Stage 2: House selection**
- Selection of households

**EL ORO PROVINCE**
- CITY OF MACHALA
  - Grid of potential clusters
  - Excluded clusters
  - Potential clusters
  - AREA 1: Intervention
    - Full
    - Limited
  - AREA 2: Comparison
    - Full
    - Limited
  - 5 clusters
  - 5 clusters
  - 5 clusters
  - 5 clusters

**Analysis**
- Phase 1: Situational Analysis
- Phase 2: Intervention Evaluation

**Policy Review**
- Scale up consideration
Appendix 2 – Key informant semi-structured interview guide and survey instruments

Key Informant Interview Guide:

1) Can you tell me about the largest/most important health problem in Machala?

2) Describe your personal experience with dengue fever. Does it affect your family? (probe: do you think that dengue is a serious problem in Machala?)

3) Whose responsibility is dengue prevention in Machala? The government? The community? Why?

4) How are you involved with dengue prevention in Machala? **Interviewer focus the following questions within the scope of the interviewee’s involvement in dengue prevention. If the response is “no involvement” focus the following questions within the sphere of personal life.**

5) What is the most reliable source of information about dengue fever?

6) How do you get your information regarding dengue outbreaks?

7) When you have information about dengue (or other health information) with whom do you share it first?

8) Can you describe the three most important groups involved with dengue prevention and control in Machala? Are they connected? How are they connected?

9) In terms of how dengue prevention/control programs are evaluated in Machala:
   a. Can you define and/or describe cost?
   b. Can you define and/or describe effectiveness?
   c. Can you define and/or describe acceptability?
   d. Can you define and/or describe sustainability?

10) What role should communities play in determining and evaluating health policy and programming?
11) What role should the government play in determining and evaluating health policy and programming?

12) What role should research play in determining and evaluating health policy and programming?

13) What is the best way to ensure that the voice of the community is heard, understood and valued by policy-makers?

14) Is there anything you would like to add to this conversation? Are there any important points that should be considered in this research endeavour that we have not discussed?
Participatory indicator development instruments

Gestión Participativa de Indicatoras y Matriz de Evaluación

Participante:______________________________
Grupo de Actores Sociales:_____________________
Fecha:__________________________ Encuestador:________________________

La siguiente encuesta debería considerado específicamente desde el punto de vista de evaluar programas de *prevención* de dengue. Al propósito de este encuesta, por favor considere la prevención del dengue en vez de tratamiento o manejo de casos.

**Criterios Gruesos:**
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

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<tr>
<td>1. Costo</td>
<td>EC1</td>
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<tr>
<td>2. Eficacia</td>
<td>EC2</td>
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<td>3. Aceptabilidad</td>
<td>EC3</td>
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<td>4. Sostenibilidad</td>
<td>EC4</td>
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<tr>
<td>5. Otro:</td>
<td>EC5</td>
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**Evaluación de Costo**
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

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<td>6. Recursos Humanos</td>
<td>EC6</td>
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<td>7. Transporte (Movilización)</td>
<td>EC7</td>
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<td>8. Suministros</td>
<td>EC8</td>
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<td>9. Otro:</td>
<td>EC9</td>
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**RECURSOS HUMANOS**
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

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<td>10. Inspectores/Promotores de Salud</td>
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<td>11. Funcionarios del SNEM</td>
<td>EC11</td>
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<td>12. Médicos y Enfermeras</td>
<td>EC12</td>
</tr>
<tr>
<td>13. Estimulos para coordinadores de la comunidad</td>
<td>EC13</td>
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<td>14. Otro:</td>
<td>EC14</td>
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**MOVILIZACIÓN**
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

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<td>15. Vehículos y choferes del Ministerio de Salud Pública</td>
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<td>16. Volquetas y choferes del Municipio para hacer mingas</td>
<td>EC16</td>
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<td>17. Movilización del SNEM para fumigación y visitas domiciliares</td>
<td>EC17</td>
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<td>18. Combustible</td>
<td>EC18</td>
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<td>19. Otro: ____________________________</td>
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**SUMINISTROS**
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

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<td>20. Insecticidas</td>
<td>EC20</td>
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<td>21. Materiales educativas</td>
<td>EC21</td>
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<tr>
<td>22. Tapas para tanques</td>
<td>EC22</td>
</tr>
<tr>
<td>23. Refrigerios para reuniones comunitarias</td>
<td>EC23</td>
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<td>24. Otro: ____________________________</td>
<td>EC24</td>
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**Evaluación de Eficacia**
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

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<tr>
<td>25. Cantidad de mosquitos o larvas en el barrio (Índices vectoriales)</td>
<td>EC25</td>
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<tr>
<td>26. Participación comunitaria</td>
<td>EC26</td>
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<tr>
<td>27. Cantidad de casos en el barrio (Índices epidemiológicos)</td>
<td>EC27</td>
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<td>28. Otro: ____________________________</td>
<td>EC28</td>
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**ÍNDICES VECTORIALES**
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

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<tr>
<td>29. Pupas por persona</td>
<td>EC29</td>
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<td>30. Porcentaje de hogares positivos por vectores</td>
<td>EC30</td>
</tr>
<tr>
<td>31. Identificación de tipos de recipientes más peligrosos</td>
<td>EC31</td>
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<td>32. Otro: ____________________________</td>
<td>EC32</td>
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**PARTICIPACIÓN COMUNITARIA**
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

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<tr>
<td>33. Cantidad de patios limpios y ordenados en el barrio (%)</td>
<td>EC33</td>
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<tr>
<td>34. Cantidad de tanques bien tapados en el barrio (%)</td>
<td>EC34</td>
</tr>
<tr>
<td>35. Cambio de hábitos dentro la casa</td>
<td>EC35</td>
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36. Otro:____________________________________

ÍNDICES EPIDEMIOLÓGICOS
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

37. Incidencia del dengue

38. Número de casos confirmados de dengue

39. Frecuencia e intensidad de brotes y epidemias

40. Otro:____________________________________

EVALUACIÓN DE ACEPTABILIDAD
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

41. Opiniones de participantes (actores sociales)

42. Participación

43. Si ha reproducido cambios en la forma de vivir de la gente

44. Bienestar de personas y comunidades

45. Otro:____________________________________

OPINIONES DE ACTORES SOCIALES
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

46. Preguntando casa por casa o en su trabajo

47. Comunicación a través de líderes establecidos

48. Reuniones

49. Encuestas breves

50. Otro:____________________________________

PARTICIPACIÓN
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

51. Asistencia a reuniones

52. Cumplir en casa con las actividades del programa

53. Cambios de hábitos dentro la casa

54. Otro:____________________________________
CAMBIOS EN LA FORMA DE VIVIR
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

55. Actividades al nivel de familia y comunidad incorporan conceptos del programa

56. La manera de hablar y actividades educativas incorporan conceptos del programa

57. Actividades políticas de las autoridades incorporan conceptos del programa

58. Otro:____________________________________

BIENESTAR DE PERSONAS Y COMUNIDADES
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

59. Provisión adecuado de infraestructura sanitaria y servicios básicos

60. Ideas de la comunidad están considerados y aplicados en el proceso de tomando decisiones por el programa

61. Mejoramiento del barrio y el medio ambiente

62. Otro:____________________________________

EVALUACIÓN DE SOSTENIBILIDAD
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

63. Coordinación entre instituciones y la comunidad

64. Autosuficiencia de la comunidad (Empoderamiento)

65. Institutionalización de la programa

66. Comunicación del resultados

67. Otro:____________________________________

COORDINACIÓN
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

68. Cantidad de grupos actores sociales participando

69. Frecuencia de reuniones, eventos y actividades colaborativas

70. Convenios institucionales

71. Otro:____________________________________
**EMPODERAMIENTO DE LA COMUNIDAD**
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

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<td>72. Nivel de que la comunidad asuma la responsabilidad por el programa</td>
<td>EC72</td>
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<td>73. Cantidad de grupos comunitarios involucrados en actividades del programa</td>
<td>EC73</td>
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<tr>
<td>74. Nivel de inclusión de la comunidad dentro los procesos de tomando decisiones para la gestión, evaluación y implementación del programa</td>
<td>EC74</td>
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<td>75. Other:___________________________________</td>
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**INSTITUCIONALIZACIÓN DE PROGRAMA**
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

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<td>76. Recursos económicos</td>
<td>EC76</td>
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<td>77. Implementación institucional de estrategias recomendadas</td>
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<tr>
<td>78. Seguimiento y evaluación continuo de actividades y resultados del programa</td>
<td>EC78</td>
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<td>79. Otro:______________________________</td>
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**COMUNICACIÓN DEL RESULTADOS**
¿Qué nivel de importancia da usted a los siguientes criterios de evaluación?

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<td>80. Comunicación por TV, radio y periódicos</td>
<td>EC80</td>
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<td>81. Comunicación por reuniones y charlas</td>
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<td>82. Comunicación por folletos y trípticos</td>
<td>EC82</td>
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<td>83. Otro:______________________________</td>
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Está usted comprometido de asistir a la reunión la próxima semana para trabajar en los resultados de este encuesta?

SÍ   NO

**GRACIAS POR SU PARTICIPACIÓN**

Short community participation, empowerment and well-being survey
Encuesta de Participación, Empoderamiento y Buen Vivir de la Comunidad

Para las siguientes preguntas, por favor evaluar su barrio usando esta escala de impresiones:

1 = Nada  2 = Un Poquito  3 = Mas o Menos  4 = Bueno  5 = Excelente

### Participación:

1. Yo y mis vecinos participamos en las actividades de prevención y control de dengue aquí en mi barrio. □ AS1
2. Yo y mis vecinos estamos informados frecuentemente sobre nuevos programas y actividades de prevención de dengue directamente, en reuniones y/o a través de nuestro presidente barrial □ AS2
3. Pienso que la gente de mi barrio están preguntando por sus opiniones antes que el Ministerio de Salud Pública o la Red Municipal de Salud lanzan nuevas estrategias de prevención de dengue en mi sector. □ AS3
4. Decisiones del Ministerio de Salud Pública y la Red Municipal de Salud incluye los opiniones de la ciudadanía de Machala como yo. □ AS4
5. Ciudadanos, como yo y mis vecinos, tenemos oportunidades para participar en la evaluación de los programas de la prevención y control del dengue. □ AS5

### Empoderamiento:

1. Los moradores de mi barrio participan en eventos barriales y votan en las elecciones del directivo del barrio. □ AS6
2. Los moradores de mi barrio tienen opiniones fuertes sobre la manera en que las autoridades manejan programas de prevención y control del dengue en mi sector. □ AS7
3. Los moradores de mi barrio asisten a reuniones y expresan sus verdaderas opiniones frente las autoridades cuando tienen la oportunidad. □ AS8
4. Mi barrio tiene la capacidad de influir el proceso de gestión y implementación de programas de salud por el Ministerio de Salud Pública y el Municipio. □ AS9
5. Los moradores de mi barrio apoyan uno al otro y preocupan por la salud y seguridad de la comunidad. □ AS10

### Buen vivir:

1. Yo y mi familia, estamos seguros en el ámbito de mi barrio. □ AS11
2. Tengo acceso a todos los servicios que necesita mi familia para estar saludable. □ AS12
3. Me siento orgulloso de mi barrio y su imagen □ AS13
4. Creo que la gente da mucha importancia al barrio mismo y a la salubridad □ AS14
5. Tenemos un buen calidad de vida en mi barrio. □ AS15
Short community participation\(^1\), empowerment\(^2\) and well-being\(^3\) survey

For the following questions rate your community on the scale of 1 to 5 as follows:

1 = none, 2 = weak, 3 = fair, 4 = good, 5 = excellent

Participation:

1) My neighbours and I participate in community activities for dengue prevention and control
2) My neighbours and I are regularly informed about dengue prevention program decisions directly, at meetings or through our neighbourhood president
3) I feel that people in my neighbourhood are consulted before decisions are made with respect to dengue prevention and control activities in my sector
4) Dengue prevention and control decisions within the Ministry of Health, SNEM or the Municipal Health Network often include the point of view of regular people
5) Regular people, like myself and my neighbours, have the opportunity to participate in the evaluation of dengue prevention and control strategies

Empowerment:

1) The people in my neighbourhood participate in neighbourhood activities and vote in neighbourhood elections
2) The residents in my neighbourhood have strong opinions about how the Ministry of Health and The Municipal Government of Machala execute dengue prevention and control programs as well as other health programs in our sector
3) The people in my neighbourhood attend meetings and express their opinions truthfully to government authorities when they have the opportunity
4) My neighbourhood can influence the way that programs and policies are made within the ministries and the municipality.
5) The residents of my neighbourhood are supportive of one another and are concerned with each other’s health and security.

Well Being:

1) I feel safe living in my neighbourhood
2) I feel that I have access to the services and resources my family needs to stay healthy
3) I feel proud of my neighbourhood and the way it looks
4) I feel that my neighbourhood is important to the people that live here
5) We have a good quality of life in my neighbourhood

\(^1\) Adapted from Sanchez et al. (2009) Intersectoral coordination, community empowerment and dengue prevention: six years of controlled interventions in Playa Municipality, Havana, Cuba. Tropical Medicine and International Health. 14 (11): 1356-1364


\(^3\) Derived from initial impressions and rough analyses of the Social Analysis (key informant interviews, focus groups and community meetings) by K. Mitchell-Foster
Appendix 3 – Code book
Acceptability: The measurement of the Acceptability of the program(s) by each of the stakeholder groups individually or all together

Acceptability>Integrtn: Denotes the evaluation of acceptability of a dengue prevention and control program through the measurement of the degree to which concepts and prescribed activities of the program are integrated into everyday life for a range of stakeholder groups

Acceptability>Integrtn>FamCom: Denotes the evaluation of program acceptability of the integration of program concepts into the normal daily activities of families and communities

Acceptability>Integrtn>Politic: Denotes the inclusion of program results, concepts and language in political discourse, decisions and activities

Acceptability>Integrtn>RhetEdu: Denotes the evaluation of program acceptability through the degree of integration of program concepts and language into daily rhetoric and educational activities/materials

Acceptability>Particip: Denotes the evaluation of program acceptability through direct measurement of community participation

Acceptability>Particip>ChgBhvr: Denotes the evaluation of program acceptability through observed behaviour changes within the home

Acceptability>Particip>Home: Denotes the evaluation of acceptability through monitoring activities within the home as to whether or not they include program norms

Acceptability>Particip>Mtg: Denotes the evaluation of acceptability based on participants attending meeting scheduled by government administrators, government frontlines, researchers with or without input from the community

Acceptability>StkhldrOp: Denotes the measurement of program acceptability through directly asking for the opinions and experiences of stakeholders from all stakeholder groups

Acceptability>StkhldrOp>ComLead: Denotes the evaluation of program acceptability through the communication of stakeholder opinions through their appointed or elected leaders; i.e. community presidente, unit leaders for health centres, Juntas Parroquiales
Acceptability>StkhldrOp>F2F: Denotes the evaluation of program acceptability through asking stakeholder opinions directly, face to face in their places of work or residence.

Acceptability>StkhldrOp>Mtgs: Denotes the evaluation of program acceptability through asking stakeholder opinions at meetings.

Acceptability>StkhldrOp>ProfConfidence: Denotes the opinions about acceptability of practitioners and administrators that accept the programs as valid from the point of view of their professional roles.

Acceptability>StkhldrOp>Surv: Denotes the evaluation of program acceptability through asking stakeholder opinions through short structured surveys in their places of work or residence.

Acceptability>WellBeing: Denotes the evaluation of the acceptability of a program through the effect it has on community well-being overall.

Acceptability>WellBeing>ComEnv: Denotes the evaluation of acceptability of a program through the degree of inclusion for plans or advocacy for improvement of the physical and built environment; these are typically not included in dengue prevention programs, however, with the focus on social determination of dengue, these ought to be included in the evaluation process and matrix.

Acceptability>WellBeing>ComOp: Denotes the evaluation of program acceptability through the degree to which program activities and decisions include the opinions and experiences of the communities involved.

Acceptability>WellBeing>Sanitary: Denotes the evaluation of program acceptability through the provision of potable water and basic sanitary infrastructure. This is normally not included in a dengue prevention program, however, with looking at the social determination of dengue, this ought to be included in the evaluation.

ComPath: Denotes the description of a communication pathway between stakeholder groups or individuals and their surrounding communities.

ComPath>official: Denotes an "officially recognized" communication pathway either a product of institutional structure and protocol, or a professional cultural expectations.

ComPath>official>action: Denotes communication through official pathways that directly results in action to prevent dengue transmission or positive change.
ComPath>unofficial: Denotes a communication pathway that is outside the realm of "officially recognized" rhetoric, communication or information/knowledge exchange.

ComPath>unofficial>action: Denotes communication through unofficial pathways that directly result in action to prevent dengue transmission or to effect positive change

Cost: Broad category for Evaluation Criteria. This category covers all kinds of costs, including those that are non-economic

Cost>HR: Subcode denoting financial and time requirements of skilled human resources to carry out programming, evaluation and policy-making

Cost>HR>Ins: Code denoting the human resources needed to fulfill the roles of health inspectors (MoH) or community health promoters

Cost>HR>Med: Denotes the cost associated with investing in specialized medical personnel for dengue prevention control and treatment. Including Doctors and nurses, both clinical and public health.

Cost>HR>VecCont: Denotes the financial and time requirement to have workers to fulfill the roles of vector control personnel to visit homes and inspect them, to fumigate homes and neighbourhoods and to give talks/educational seminars

Cost>Supplies: Denotes the dedication of a budget to include supplies for a community-based dengue prevention program

Cost>Supplies>Chem: Denotes the cost for chemical mosquito control agents such as temephos larvicide, bio larvicide, malathion backpack spray and vehicle-mounted fumigation

Cost>Supplies>EdMat: Denotes the budgetary provision for new educational materials of different kinds and their development

Cost>Supplies>Refrigerio:

Cost>Supplies>TankCovers: Denotes the cost of "intervention support" supplies. If the intervention is focused on covering tanks, this may provide insight into the question of "is it useful to provide tank covers?" As dengue risk is most critical in more economically unstable neighbourhoods, the question persists regarding material support for control efforts.

Cost>Trans: Denotes the cost of transport of human resources and supplies to
the communities for prevention and control efforts. The availability of vehicles and drivers is crucial to the prevention of dengue on-site in the different neighbourhoods of Machala

Cost>Trans>Gasoline: Denotes the importance of a dedicated budget for gasoline to enable the mobilization of vehicles and human resources

Cost>Trans>MoH: Denotes the cost of vehicles and drivers to bring Doctors, nurses and health promoters to neighbourhoods

Cost>Trans>Municip: Denotes the cost of vehicles and drivers for Mingas

Cost>Trans>VecCont: Denotes the cost for bringing vector control personnel to neighbourhoods for fumigation, house inspection and spraying, larviciding and for educational talks

Efficacy: Denotes the evaluation of the intervention in reducing larval indices, a proxy for dengue transmission risk in Machala. In the comparative analysis there should be a provision for looking at the differential effect on other indicators, following the outlined categories within this criterion

Efficacy>ComPartic: Denotes the measure of efficacy of a participatory program through changes or monitored community participation. These are usually "evidenced participation" or "arms length" indicators

Efficacy>ComPartic>ChgBhvr: Denotes the measurement of community participation through evidenced behaviour changes; i.e. putting larvicide in cisterns, cleaning them out with an increased frequency. Are communities changing the way they manage their water, etc. in accordance with program suggestions?

Efficacy>ComPartic>PatLimp: Denotes the measurement of participation through the classification of a patio as "limpio" through a spot-check visit.

Efficacy>ComPartic>TankTap: Denotes the measurement of community participation through observing compliance with covering tanks, cisterns and water storage containers.

Efficacy>EpiInd: Denotes the measurement of program efficacy through the increase/decrease in epidemiological indices in intervention vs. control paired neighbourhoods.

Efficacy>EpiInd>DenInc: Denotes the evaluation of program efficacy through the measurement of dengue incidence
Efficacy>EpiInd>FreqEpi: Denotes the evaluation of program efficacy through the monitoring of outbreak and epidemic frequency in neighbourhoods, parroquia or city-wide

Efficacy>EpiInd>NumTreat: Denotes the evaluation of program efficacy through the measurement of number of persons treated for dengue or dengue-like symptoms classified as dengue (without laboratory tests)

Efficacy>VectInd: Denotes the measure of success as it pertains to diminishing dengue transmission risk as is implied through the proxy of vector indices

Efficacy>VectInd>Container: Efficacy of the intervention measured through the identification of most productive container types in each neighbourhood, and through specifically targeting their control in each neighbourhood, observing changes in numbers of larvae counted in each. Do the most productive container types change through the intervention?

Efficacy>VectInd>HI: Efficacy as measured through the house index in paired treatment and control neighbourhoods. Hous index is the proportion of houses positive for the presence of the vector (aquatic stages) per 100 houses inspected.

Efficacy>VectInd>PPP: Efficacy of intervention as measured by the calculation of Pupae Per Person index within the paired treatment and control neighbourhoods

HealthPriority: Denotes the discussion of health concerns of the individual, community or stakeholder group involved with the interview or focus group

HealthPriority>Dengue: Denotes the identification of Dengue as the number one health issue, or as a health priority within a group of priorities

HealthPriority>Environment: Denotes environmental degradation or policies that neglect the connection between human and environmental health

HealthPriority>Other: Denotes the discussion of other health issues and their prioritization ranking higher than dengue, or mentioned within a group of priorities that includes dengue

HealthPriority>SocioculturalDeterminants: Denotes the identification or implication of a need to shift the framing of dengue prevention and control programming from one of biomedicalization, curative or vertical targeting to one of social, cultural determinants, horizontal preventive strategy (EcoHealth-esque).
Information: Denotes the description of information flow, quality, type and/or needs regarding information systems within the realm of dengue prevention and control in Machala and beyond.

Information inadequatesystems: Denotes the experience of existing information systems as inadequate to enable full visualization of the dengue dynamic (i.e. transmission patterns, real-time responses at the medio-macro level), to enable quick responses in the face of an epidemic threat, to sufficiently predict epidemics, to respond to neighbourhood-level indices (smallest geo-political unit available through existing info systems is the parroquia).

Information quality: Denotes the concern regarding the quality of information that is relayed throughout the existing info system.

Information quality incomplete: Denotes the reliance on information that is of poor quality because it is incomplete for the purposes of case follow-up and control efforts. This is especially important because it impedes epidemic suppression and control activities that ought to be done with expediency.

Information quality trustworthy: Denotes confidence in the kinds of information that are provided through current programs and information systems.

Information quality underestimation: Denotes the insufficient estimation of dengue incidence, prevalence, positives and numbers treated through the current system. This may be an indicator of a widespread mistrust of the "official" data provided through the epidemiological info systems of MoH.

Information quality timely: Denotes the importance of timing in dengue prevention programs and information systems. Often info flow is too slow, epidemics are developing while data is moving through channels; denotes a frustration on the part of practitioners regarding timeliness of implementation of prevention and control activities.

Information quality untrustworthy: Denotes the lack of confidence in information provided by the current programs and information systems.

IntersectoralSpace: Denotes the existence or need for intersectoral collaboration.

IntersectoralSpace abandoned: Denotes the identification of an intersectoral space that was once successfully used but that is no longer available or used.

IntersectoralSpace extant: Denotes the identification of an existing and "in use" intersectoral space for collaboration.
IntersectoralSpace>new: Denotes the identification of a new intersectoral space or the need for the creation of intersectoral collaboration in order to improve or change dengue prevention and control programs.

JusticiaSocial: Denotes the invocation of Social Justice action for equitable access to information, services and an equitable share of decision-making power for all stakeholders.

JusticiaSocial>health: Denotes the invocation of social justice in health as an important focus in order to move forward in a new way.

JusticiaSocial>infrastructure: Denotes the invocation of the concept of social justice as the reason for prioritizing the building and provision of basic sanitary infrastructure in those neighbourhoods that do not have it; carries the connotation of changing the prioritizing framework from capitalism and serving the middle and upper classes to social justice and bringing the marginalized and peripheral neighbourhoods into the priorities.

JusticiaSocial>political: Denotes the requirement for a social justice focus in the political process moving forward with decisions; a proposed new way of power-sharing for the well-being of all.

JusticiaSocial>political>transparency: Denotes the identification of a need for transparency in decision making processes that include input from the public. Carries a connotation of suspicion of corruption and favouritism in public works and political mechanisms.

JusticiaSocial>recognitionvoice: Denotes the invocation of the concept of social justice with regard to decision-making processes that historically exclude the voice of the community. Again, suggests a changing of the priority-setting framework to one of social-justice orientation.

JusticiaSocial>UnpaidOvertime: Denotes the mention of frontline workers and other government workers putting in hours far beyond their requirement for their salary. Carries with it a connotation of expectation on the part of the ministry or governing agency; that without the unpaid overtime programs would not function, and that the governing agency rarely recognizes or publicly appreciates the extra effort.

PersonalExp: Denotes a discussed personal experience with Dengue.

PersonalExp>Neg: Denotes a personal experience at the level of understanding that it is common within their circle or community. That none of their family, close friends or themselfed have ever had dengue.
PersonalExp>Pos: Denotes a discussion of an experience of dengue within their immediate circle or community

PersonalExp>Pos>Fam: Denotes a personal experience with someone suffering or dying from dengue in their family

PersonalExp>Pos>Neighbourhood: Denotes a personal experience with dengue that consists of neighbours and community members affected with dengue

PersonalExp>Pos>Prof: Denotes a personal experience with a person suffering or killed by dengue through their professional roles as vector control, health care practitioners, or government employees

PersonalExp>Pos>Self: Denotes their primary experience with dengue is they themselves have had it

PowerImbalance: Denotes the description of unequal or inequitable power sharing in the designing and execution of the research project itself, as well as the implementation and decision making regarding the dengue prevention program itself.

PowerImbalance>Decision: Denotes the unequal or inequitable distribution of planning and decision-making power within the structure of the TDR project as it directly pertains to the way that the implementation of the intervention and data collection are carried out

PowerImbalance>Decision>Admin: Denotes the concentration of decision-making power within the administrative sector of government; including both Ministries and Municipalities

PowerImbalance>Decision>Community: Denotes the inequitable power-sharing dynamic that communities are not included in the decision-making process that determines their health programming, but are expected to comply with that same programming

PowerImbalance>Decision>Researcher: Denotes the inequitable process by which researchers "do projects" one after another and the people are not privy to the results, do not experience benefit the way they believe they should, and are not asked to be part of the process that evaluates those projects

PowerImbalance>Decision>Worker: Denotes the inequitable power-sharing with frontline ministry and municipality workers in that they are the ones "doing the work" and gathering in formation, yet their observations, suggestions and
feelings are often disregarded when making decisions.

PowerImbalance>Global: Denotes the acknowledgement of decision-making power and funding coming from outside Ecuador, also carries the connotation that the credit and/or determining goals, theoretical frameworks and motivations are not Ecuadorian. Also carries the connotation that the results of Ecuadorian work will be carried out of the country and will be appropriated in such a way as they lose their Ecuadorian quality and become less (or not, as in the case of publications in English) accessible to the people who did the work on the ground to generate the data.

PowerImbalance>PwrNorth: Denotes the acknowledgement of the historical power-over and governance structure of decision-making power and prestige concentrated in the North of Ecuador. In this case it may also reflect the paternalistic administration of funds through the financial department of UASB and how that restricts work on the ground in Machala.

PowerImbalance>PwrSouth: Denotes acknowledgement of decision-making power concentrated in the Southern parts of Ecuador. Not a strong dynamic, very rarely does this happen with Intra-Ecuadorian North-South collaboration.

PrevStrategy: Denotes the strategy used to prevent dengue transmission and the presence of Aedes aegypti mosquitoes

PrevStrategy>Chem: Denotes a chemical or insecticide-based dengue prevention strategy

PrevStrategy>Criad: Denotes a breeding-site reduction prevention campaign, normally carrying the connotation of increased community participation and reduced use of chemicals

PrevStrategy>Edu: Denotes a primarily education-based dengue prevention program, usually carrying the connotation of being executed with the source-reduction campaign and increased community participation

PrevStrategy>Integrated: Denotes a fully-integrated dengue prevention strategy employing all three elements of insecticide use, education and source reduction campaign.

Quemeimportismo: Defined as the perception of the community and/or lower-level (frontline) MoH workers as not caring about dengue prevention programs as evidenced by the persistence of the problem. Victim-blaming behaviour based on "evidenced" program non-compliance
Apathetic: Quemeimportismo observed as the result of an innate lack of conscience regarding a community's or group's own situation, a lack of caring about "bettering one's own circumstances". Victim blaming

FutileCom: Quemeimportismo acknowledged or explained through anecdotal evidence regarding the futility of community education efforts and health promotion efforts by health programs.

Ignorance: Quemeimportismo observed as a result of a lack of education or "knowing" regarding dengue prevention and control and/or transmission in specific communities or operative units.

Noncompliance: Quemeimportismo observed as a disconnect between education levels, resources and compliance with prevention program directives. Carries a connotation of a conscious defiance or active "non-participation" with prevention and control efforts.

question: structures the interview/focus group according to the questions asked by the interviewer/focus group leader to prompt conversation

ResentSocial: Denotes the resentment that historically marginalized stakeholders feel toward the historically powerful stakeholders in the processes of determining how services are provided and to whom. Also carries the connotation of resentment of the dynamics of paternalism and victim-blaming which the "authorities" (this can include governments, admins, researchers, universities) are thought to actively engage in.

Amiguismo: Denotes the resentment of the practice of nepotism and showing favour to friends and connected colleagues in the sharing of power and in the provision of resources, services and infrastructure.

LackOfServices: Denotes the element of resentment borne of the "evidenced" lack of caring and lack of respect for communities in that they continue to live without basic services despite years of struggle. This experiential element of the resentment dynamic is important because these communities are still subjected to victim-blaming rhetoric of paternalistic programming; a cyclic dynamic that self-reinforces.

NeedsNotMet: Denotes the element of resentment borne of the "evidenced" lack of caring and lack of respect for communities in that they continue to have poor access to basic primary health care and that they have little to no contact through health inspectors and the comisario de salud to address public health concerns within their communities; yet they are still expected to comply with directives when specialized programs come down from
ResentSocial>Paternalismo: Denotes the element of resentment that stems from paternalistic dengue prevention and control programming whereby the implementation of that programming excludes equitable involvement of communities and carries with it the expectation that communities will show their participation through non-questioning compliance.

Roles: Denotes the identification or perception of the role of a stakeholder group within the realm of dengue prevention and control in Machala

Roles>Community: Denotes the perception or identification of the role of communities in dengue prevention and control programs

Roles>Community>actual: Denotes the perception or identification of the roles that communities play in actuality, in current prevention and control efforts

Roles>Community>ideal: Denotes the perception of what the ideal role for communities would be in a participatory dengue prevention program

Roles>Government: Denotes the identification/perception of the role that the government (either Ministry, provincial or municipal) plays in dengue prevention

Roles>Government>actual: Denotes the role that governments play in actuality in dengue prevention and control

Roles>Government>ideal: Denotes the perception/identification of the ideal role for a government to play in dengue prevention and control programs

Roles>Researchers: Denotes the identification/perception of the role that researchers play in dengue prevention and control programming

Roles>Researchers>actual: Denotes the identified/perceived role that researchers play in the development and implementation of dengue prevention and control programs in actuality

Roles>Researchers>ideal: Denotes the perceived/identified ideal role that researchers should play within participatory dengue prevention programming

speaker: This code denotes who is speaking. Used to distinguish between interviewer/focus group leader and interviewee/focus group participants

StakeholderID: Denotes the identification of an important stakeholder group within the stakeholder universe of dengue prevention and control in Machala
StakeholderID>Cnxn: Denotes a connection between identified important stakeholder groups

StakeholderID>Cnxn>official: Denotes an officially recognized connection between groups, or a connection between groups that behaves as dictated by the confines of an officially recognized system

StakeholderID>Cnxn>unofficial: Denotes a connection between stakeholder groups that in unofficial or does not behave or is not valued within or by officially recognized systems

Sustainability: Denotes the evaluation of a dengue prevention program for Sustainability: this includes the gamut of definitions of sustainability, i.e. environmental, financial, duration, social

Sustainability>ComEmpower: Denotes the evaluation of Sustainability through the degree to which a community is empowered by program activities, establishment and implementation, evaluation

Sustainability>ComEmpower>DegInvolv: Denotes the evaluation of Sustainability through community Empowerment by monitoring the degree to which communities are involved in the process of planning, developing, implementing and evaluating the program

Sustainability>ComEmpower>NumActiveComGrp: Denotes the evaluation of Sustainability through community empowerment by monitoring the number of active community groups in the program

Sustainability>ComEmpower>ProgOwnership: Denotes the evaluation of sustainability and community empowerment through measuring the degree to which a community takes ownership of program activities within their own neighbourhood

Sustainability>Communication: Denotes the evaluation of program sustainability through the monitoring or measuring of the way that results, current activities and proposed activities are communicated to all involved stakeholder groups and the general public

Sustainability>Communication>Mtgs: Denotes the evaluation of sustainability and communication of results/activities through communication via meetings and presentations. this is the traditional route, it reaches a smaller and more specific audience with more in-depth information
Sustainability>Communication>Pamphlets: Denotes the evaluation of sustainability and communication of results/activities through the distribution of written summaries geared toward the general public in the form of leaflets, pamphlets and posters

Sustainability>Communication>perifoneo: Denotes the identification of perifonear as a communication strategy to spread awareness and encourage people to attend meetings

Sustainability>Communication>TVRadNews: Denotes the evaluation of sustainability and results/activities communication through the use of press, radio and television. (this measure of sustainability can be useful for estimating the "audience" or how far the public investment in the program reaches; on the other hand how wide the "responsibility base" has been extended by the program

Sustainability>InterCoord: Denotes the evaluation of program sustainability through measuring the degree of Intersectoral Coordination that is fostered or sustained through program activities

Sustainability>InterCoord>Convenio: Denotes the evaluation of program sustainability and intersectoral coordination through the recording of official agreements to cooperate (i.e. between institutions, communities and gouvernements)

Sustainability>InterCoord>FreqActivity: Denotes the evaluation of sustainability and intersectoral coordination through the measurement of the frequency of program activities involving various sectors and stakeholder groups

Sustainability>InterCoord>NumGroups: Denotes the evaluation of Intersectoral Coordination through the measuring of the number of diverse stakeholder groups that are involved in program activities

Sustainability>ProgInstit: Denotes the evaluation of Sustainability through the measuring the degree to which a project or vertical program is institutionalized, this is often seen as a determinant of program longevity

Sustainability>ProgInstit>Finance: Denotes the evaluation of Sustainability and Program institutionalization through the measurement or recording of official financial commitments or dedicated financial resources for program implementation and operation

Sustainability>ProgInstit>FollowupEval: Denotes the evaluation of sustainability and program institutionalization through the ongoing commitment to ongoing monitoring, evaluation and follow-up of program activities
Sustainability>ProgInstit>Implement: Denotes the evaluation of sustainability through program institutionalization by measuring the level to which results, evidence and recommended strategies are implemented within the institutions involved.
### Appendix 4.1 Analysis table for stakeholder relationships to one another and to the problem of persistently high dengue indices

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
<th>Stakeholder relationships with the problem of persistently high <em>Aedes</em> indices, dengue incidence and insecticide-based control and each other</th>
<th>Capacity/motivation to the participate in addressing the problem</th>
<th>Relationship with other stakeholders (e.g., partnership or conflict)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ministry of Health (MoH)</strong></td>
<td>Current control program is costly, human-resources intensive and high <em>Aedes</em> indices persist. There is a push toward reducing the use of insecticides to reduce environmental contamination, this is in conflict with the pressure to keep dengue incidence down using available measures</td>
<td>Political pressure from communities and government actors to reduce costs and implement more effective control program</td>
<td>Partnership with all MoH departments, UASB, UTM. Conflict with Municipal Government in terms of taking responsibility for dengue control. Mixed relationship with community; service provision is in conflict with budget management and level of community participation</td>
</tr>
<tr>
<td><strong>Provincial Director MoH</strong></td>
<td>Trade-offs between resource allocation and population needs. Pressure to deliver services and improve health indicators with a recently reduced human resources pool</td>
<td>Political voice of the Province of El Oro in health policy-making process, brings gathered evidence to the policy-making table, is looking to lower dengue incidence</td>
<td>As above; Also shares a cooperative alliance with Provincial Director of Education with health education programs, partnership with Provincial Department of Epidemiology</td>
</tr>
<tr>
<td><strong>Health Area (MoH)</strong></td>
<td>Administrative units are directly involved in prevention activities and oversee treatment guidelines of cases, educational campaigns</td>
<td>Gathering evidence and critical mass of practitioners to support policy changes for improved prevention to ease the burden of treating cases, often initiate and are involved in community health programs and projects; team members are known to communities</td>
<td>In close partnership with Health Centres and Sub-centres through administrative team, seen as approachable resource people and powerful stakeholders by Sub-centres and communities; close partnership with Provincial Department of Epidemiology; partnership with community</td>
</tr>
<tr>
<td><strong>Health Centres (MoH)</strong></td>
<td>Treat clinical cases, provide support for prevention programs, coordinate Area-wide control strategies in emergent situations</td>
<td>Larger centres have longer operating hours and are seen to have more capacity to deal with clinical cases often leading to an overload of patients from the catchment area. Prevention would reduce cases and free human and clinical resources for other needs</td>
<td>Health Centres operate in close partnership with administrative units and Sub-centres. Conflict arises in relationship with overall governance MoH actors over lack of resources and infrastructure. Conflict with communities may arise in times of dengue epidemics as the demand better attention and prevention services.</td>
</tr>
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Appendix 4.1 cont’d - Analysis table for stakeholder relationships to one another and to the problem of persistently high dengue indices

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<th>Capacity/motivation to the participate in addressing the problem</th>
<th>Relationship with other stakeholders (eg partnership or conflict)</th>
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<tr>
<td><strong>Government</strong></td>
<td><strong>Health Sub-Centres (MoH)</strong></td>
<td>Treat clinical cases within their districts, execute dengue prevention strategies (i.e. home visits, neighbourhood health education campaigns, coordination with SNEM for mosquito control, community meetings)</td>
<td>Sub-centres act as a &quot;first contact&quot; link between the community and MoH in terms of voicing community health concerns, service provision and understanding specific community health dynamics. Heath Areas expect information to arrive via these channels to inform programme decision-making and action.</td>
<td>Sub-centres operate in close partnership with Health Centres and Health Areas, with schools and community associations, with community/local governments and with SNEM. Mixed relationship with communities: partnership in terms of receiving services that are provided, conflict in terms of lack of available services and short business hours.</td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td><strong>Provincial Department of Epidemiology (MoH)</strong></td>
<td>Track clinical and epidemiological data (i.e. confirmed and suspected clinical cases of dengue fever and severe dengue) to predict, prevent and control dengue endemic and epidemic transmission. Struggling with epidemic and incidence cluster prediction due to insufficient information systems</td>
<td>Receives all epidemiological dengue transmission information from the epidemiologists of Health Areas, makes control and prevention decisions in conjunction with SNEM and MoH offices, reports to Director of MoH on dengue programme and emergent intervention decisions</td>
<td>Partnership with Director of MoH, Health Areas and Health Centres. Close partnership with SNEM (esp. Zone 8 Director) in terms of executing <em>Aedes</em> control and dengue epidemic intervention measures.</td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td><strong>National vector-borne disease control service (SNEM)</strong></td>
<td>A vertical program (within MoH) to which the vast majority of the <em>Aedes</em> control responsibility falls. Large human resources invested in house visits and door-to-door control, education and monitoring. Persistently high indices stretch resources; only 30% of the area-at-risk is routinely covered.</td>
<td>Collects, compiles and analyzes entomological data to determine how and where to administer control measures. Conventional, insecticide-intensive programs could be replaced with proposed programs in areas of low to moderate risk. Decisions are made at the level of Zone 8 Director in Machala.</td>
<td>Close partnership with Provincial Department of Epidemiology and Health Area Administrative units, UASB and UBC. Partnership with Health Centres, Sub-Centres, Ministry of Environment, Ministry of Education, local governments, schools and communities. SNEM is well-known and well-trusted.</td>
</tr>
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### Appendix 4.1 cont’d - Analysis table for stakeholder relationships to one another and to the problem of persistently high dengue indices

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<tr>
<td><strong>Government</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNEM National Director</td>
<td></td>
<td>Current control program is costly, human-resources intensive and high <em>Aedes</em> indices persist. Heavy commitment to the reduction of chemical insecticide use in mosquito control, actively seeking alternative strategies in the face of persistently high dengue incidence and changing dengue epidemiology in Ecuador.</td>
<td>Decision-maker at the national level for SNEM within the structure of MoH, reports on control program costs, risk indices and operational concerns. Dr. Beltrán's Master's project serves as a pilot for a portion of the EBS-Ecuador proposed prevention programme; promoted from Zone 8 Director October 2012.</td>
<td>Partnership with Director of MoH and all SNEM departments. Working partnership with UASB and UBC through SNEM Zone 8 for TDR-EBS-LAC project. Long-term interest and solid commitment to communities and the implementation of participatory EcoHealth-style arthropod-borne disease prevention and control programs.</td>
</tr>
<tr>
<td>Acting SNEM Regional Director</td>
<td></td>
<td>Persistently high <em>Aedes</em> indices stress human resources, control efforts and relationship with the community. Frequent dengue epidemics are a concern for the public and MoH, Zone 8 Director bears the responsibility for prevention and control strategies. Strong focus on community involvement.</td>
<td>Programming decision-maker at the regional level. A long-term commitment to the EBS-Ecuador proposed prevention program, and excellent rapport with communities facilitates community-based control and prevention efforts. Well-respected and trusted by field operatives, facilitating collection of high-quality data.</td>
<td>Close partnership with Provincial Department of Epidemiology and Health Area Administrative units, UASB and UBC. Partnership with Health Centres, Sub-Centres, Ministry of Environment, Ministry of Education, local governments, schools and communities. SNEM is well-known and well-trusted through him.</td>
</tr>
<tr>
<td>Provincial Director, Ministry of Education</td>
<td></td>
<td>As <em>Aedes aegypti</em> are day-biters, schools are transmission foci for dengue infections in children. High <em>Aedes</em> indices put large groups of children at risk while under the responsibility of MoE at school.</td>
<td>Provincial Director MoE is dedicated to participating in health education, healthy behaviour change and prevention of disease programs for children. Frequent campaigns are supported for many different health concerns. Decision maker at the Provincial level, voice in policy at the national level for El Oro.</td>
<td>Close partnership with neighbourhood schools, Provincial Director MoH and both Health Area teams. Partnership with SNEM, UTM and community.</td>
</tr>
<tr>
<td>Neighbourhood Schools</td>
<td></td>
<td>Schools and individual teachers actively look out for students' health and well-being in Machala. High <em>Aedes</em> indices are a concern.</td>
<td>Schools participate in health programs as above and individual teachers are often very keen to improve student health through lessons and activities</td>
<td>Close partnership with Provincial Director MoE, Health Sub-Centres, Health Areas, SNEM (through Zone 8 Director). Partnership with local governments and sometimes with Municipality.</td>
</tr>
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## Appendix 4.1 cont’d - Analysis table for stakeholder relationships to one another and to the problem of persistently high dengue indices

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<tr>
<td><strong>Government</strong></td>
<td></td>
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<tr>
<td><strong>Federal Deputy Minister of Environment (FDMoE)</strong></td>
<td>FDMoE is interested in how dengue transmission and high <em>Aedes</em> indices are indicators of environmental “crisis” or “adaptation” in response to climate change. Human health as a product of environmental health is a strong focus. FDMoE is a decision-maker at the national level and heads a large department of functionaries focused on monitoring, evaluating and producing potential solutions to problems created by or exacerbated by climate change. There is a significant amount of personal investment as well.</td>
</tr>
<tr>
<td><strong>Municipal Government City of Machala</strong></td>
<td>Persistently high <em>Aedes</em> indices are seen (by both the community and MoH) as a product of poor basic infrastructure (water, sewage, roads, drainage) or the total lack thereof in neighbourhoods. As well, the lack of enforcement of laws regarding vacant lots as foci for pestilence. Municipal workers and equipment are often assigned to support neighbourhood clean-up efforts (sometimes at a cost to the neighbourhood). Has unilateral decision-making ability within the municipality in terms of budget, public works infrastructure, municipal health centres, equipment and by-law enforcement through the municipal police. Municipality is constantly petitioned by neighbourhoods to improve services and infrastructure but their ability to act is severely limited by their pool of financial resources.</td>
</tr>
<tr>
<td><strong>Mayor</strong></td>
<td>Political need to address public problems is negatively affected by frequent dengue outbreaks and epidemics; although not held solely responsible (MoH bears most). Top decision-maker at the municipal level, in direct command of committees that govern resources and public policy and programming. Mayor's political will toward project can sway decision-making and funding allocation to certain areas or problems.</td>
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<tr>
<td><strong>Deputy Mayor</strong></td>
<td></td>
<td>As above. Persistently high dengue incidence spotlights the lack of basic infrastructure (water, sewers, roads) and services (garbage collection, policing, health and environmental by-law enforcement) with communities and other government authorities. This increases the budgetary and logistic demand on the Municipal Government.</td>
<td></td>
<td>As above for Municipal Government; good relationship with National Director of SNEM. Communities and some Health Sub-Centres rely on her to gain access to the political process at the municipal level, far easier to obtain an audience with her than Mayor. Often in conflict with communities over infrastructure and policing needs.</td>
</tr>
<tr>
<td><strong>Municipal Health Minister</strong></td>
<td></td>
<td>Limited budget and limited human resources determine that Municipal Health dengue prevention is seasonal, with limited coverage. Persistent intent to increase the budget of the program to have services year-round.</td>
<td>Acts as the programmatic decision-maker for the Municipal Health Program, but must stay within the budgetary and policy restrictions decided upon by the Mayor's office.</td>
<td>In partnership with the Mayor's office and other entities within the Municipal Government, in partnership with MoH entities, neutral relationship with communities, in conflict with Triple Oro private water utility.</td>
</tr>
<tr>
<td><strong>Provincial Council</strong></td>
<td></td>
<td>The council was unavailable for comment at the time of data collection</td>
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<td>The council was unavailable for comment at the time of data collection; Links to Municipal Government and Juntas Parroquiales</td>
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<tr>
<td><strong>Local Governments</strong></td>
<td></td>
<td>High <em>Aedes</em> indices, dengue outbreaks and epidemics create political pressure as communities demand better services, infrastructure and recognition of their demands within the local and municipal political process.</td>
<td>Local governments serve as the voice of the communities to the local and municipal decision-making processes, but do not possess the same power in policy or programming decisions as would Ministry or Municipal Officials.</td>
<td>Close partnership with communities, alternately highly trusted or in conflict with residents depending on the official in power. Official relationship to Municipality is partnership, but often feel ignored by the political process. Partnership with MoH and SNEM.</td>
</tr>
<tr>
<td><strong>Juntas Parroquiales</strong></td>
<td></td>
<td>As above; Particularly in the case of the semi-rural cluster at El Retiro where they are the voice for 12 different semi-rural and rural communities</td>
<td>As above; in the case of El Retiro, the President of the Junta Parroquial advocates frequently for MoH and SNEM dengue prevention intervention (i.e. application of insecticides and initiation of house-to-house clean-up and education campaigns)</td>
<td>As above; in the case of El Retiro, the Junta Parroquial is in a position of high trust and has a reputation of working with and for the people, partnerships with special interest community groups (i.e. Disabled Persons Coalition of El Oro)</td>
</tr>
<tr>
<td><strong>Neighbourhood Presidents</strong></td>
<td></td>
<td>As above for Local Governments; Neighbourhood Presidents have the ability to call council meetings and to organize community meetings, rallies, petitions or politically-motivated festivals to bring the voice of the community to Ministry and Municipal Officials and influence decision-making through multiple channels; can request specific audiences with Ministry officials and with the Deputy Mayor of Machala</td>
<td>As above for Local Governments;</td>
<td>As above; Personal connections with Ministry or Municipal Officials increase political power and agency of neighbourhood councils and, in turn, communities. Neighbourhoods can be polarized by the politics of the individual president and his/her perceived dedication to the neighbourhood; divisions within communities are common, corruption is expected</td>
</tr>
<tr>
<td><strong>Communities</strong></td>
<td></td>
<td>High level of stress associated with ongoing concerns regarding the health effects of environmental intoxication from the use of chemicals (i.e. respiratory distress/diseases) in dengue prevention, dengue and severe dengue illnesses within their families and communities, and a feeling of lack of political agency or participation in dengue prevention policy and programming</td>
<td>Varies by community, often influenced by level of community organization, socio-economic status and existent empowerment strategies employed within the neighbourhood. Many communities are highly motivated, all have the potential to engage meaningfully within the structure of a participatory program and have expressed interest in doing so, engagement seen as an opportunity to effect positive change</td>
<td>Alternately conflict and partnership with Neighbourhood Presidents/Councils and Municipality. Partnership with SNEM, MoH Health Sub-Centres, Health Area teams and schools. Partnerships exist between communities, often aligning on environmental or political issues in clusters of neighbourhoods; Neighbouring communities will advocate on one another’s behalf in the event of an audience with a politically influential body</td>
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### Appendix 4.1 cont’d - Analysis table for stakeholder relationships to one another and to the problem of persistently high dengue indices

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<td>How affected by the problem</td>
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<tr>
<td>Universidad Andina Simón Bolívar (UASB)</td>
<td>Sees dengue prevention and control dynamics in Machala as an opportunity to contribute to the development of capacity to effectively improve human health outcomes through addressing non-medical determinants of health and to re-inforce the existing discourse around human health as a product of environmental, social, political and biological factors.</td>
</tr>
<tr>
<td>University of British Columbia (UBC)</td>
<td>As above for UASB; also provides project management guidance and ethics review board support in the absence of ERBs at UASB and UTM. The Global Health Research Program at UBC has a commitment to supporting the growth and use of the EcoHealth paradigm in addressing health issues in Canada and abroad</td>
</tr>
<tr>
<td>Universidad Técnica de Machala (UTM)</td>
<td>New administration is actively seeking ties to other organizations and projects to provide opportunities for UTM students to address local issues. Dengue provides multiple disciplinary points of contact with the community</td>
</tr>
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### Appendix 4.1 cont’d - Analysis table for stakeholder relationships to one another and to the problem of persistently high dengue indices

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<td>How affected by the problem</td>
</tr>
<tr>
<td>Private Sector</td>
<td>Persistently high Aedes indices and dengue incidence are a symptom of weak public infrastructure and basic services. Triple Oro is under contract to provide municipal water service and sewerage to residents in Machala, public outcry and intense pressure from the Municipal Government over the quality of water, the availability of infrastructure and the long wait (there is a 50-year plan) for installation of infrastructure contribute to increasing uncertainty</td>
</tr>
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## Appendix 4.2 Analysis table for stakeholder motivations and impacts of the proposed community-based dengue prevention and control program

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<tr>
<th>Stakeholder Group</th>
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<th>Net impact</th>
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<tbody>
<tr>
<td>Ministry of Health (MoH)</td>
<td>Reduce program cost, decrease dengue incidence and Aedes indices</td>
<td>Lower long-term program costs, increased skilled human resource capacity, increased community participation and intersectoral cooperation with MoEd, Municipality and research stakeholders</td>
<td>If programmes are effective in reducing Aedes indices and dengue risk, community buy-in and participation could be used as an in-road to prevention of other illnesses or negative health behaviours, while having reduced long-term costs</td>
</tr>
<tr>
<td>Provincial Director MoH</td>
<td>Reduce program cost, decrease dengue incidence and Aedes indices</td>
<td>With successful implementation and scale-up of EcoHealth style dengue prevention and control programs to the provincial level, El Oro could serve as a template for other provinces. Diminished dengue incidence would alleviate a significant stress on the primary care system</td>
<td>Decreased dengue incidence and increased community consciousness and participation may promote trust and equitable collaboration for multiple health challenges. Improved dengue prevention may result in lowered expenditures on dengue treatment, freeing moneys to deal with other health campaigns</td>
</tr>
<tr>
<td>Government</td>
<td>Manage epidemiological and social information regarding human health and manage human and economic resources in program execution both in preventive and primary health care</td>
<td>Reduced paternalism in the management of dengue prevention programs should result in a less resource-intensive effort to prevent dengue and possibly fewer clinical cases requiring treatment</td>
<td>Short-term costs and possible negative perception could be high; long-term effects will likely be positive with reduced costs, draw on human resources and clinical cases. Reduced clinical cases should counteract initial negative perceptions</td>
</tr>
<tr>
<td>Health Area (MoH)</td>
<td>Support participatory prevention strategies and promote community ownership of programmes through provision of human resources to augment the efforts of Health Sub-Centres</td>
<td>Larger treatment centres treat clinical cases not attended to at MoH Sub-Centres; increased prevention may reduce number of clinical cases and free resources to deal with other diseases/problems.</td>
<td>Short-term resource re-prioritization and investment in dengue prevention should lead to increased community-ownership of prevention programs and a long-term reduction in resource drain for dengue prevention programs and treatment of clinical cases</td>
</tr>
<tr>
<td>Health Centres (MoH)</td>
<td>Support participatory prevention strategies and promote community ownership of programmes through provision of human resources to augment the efforts of Health Sub-Centres</td>
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<tr>
<td><strong>Health Sub-Centres (MoH)</strong></td>
<td><strong>Main objectives of stakeholder</strong></td>
</tr>
<tr>
<td>Improve community ownership of dengue prevention and promote healthy behaviour change within homes, schools and public spaces with respect to breeding-site reduction, lowered <em>Aedes</em> indices and dengue incidence, improved attitudes toward participatory prevention strategies and reduced insecticide use.</td>
<td>Increased community ownership of dengue prevention programs will reduce the time and resources (i.e. Health Inspector) allocated to house-to-house visits, periodic neighbourhood clean-up campaigns and application of costly insecticide. Health Inspector may assume the role of facilitator or liaison instead of coordinator and community activator.</td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td><strong>Main objectives of stakeholder</strong></td>
</tr>
<tr>
<td><strong>Provincial Department of Epidemiology (MoH)</strong></td>
<td>Decrease dengue incidence, <em>Aedes</em> indices and dengue transmission risk; Improve predictive ability regarding outbreaks and dengue epidemics.</td>
</tr>
<tr>
<td><strong>National vector-borne disease control service (SNEM)</strong></td>
<td>Decrease <em>Aedes</em> indices and dengue transmission risk effectively while reaching a larger proportion of the at-risk population; reducing costly use of insecticide, increasing community ownership of prevention programs.</td>
</tr>
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<tr>
<td>SNEM National Director</td>
<td>reducing chemical insecticide use and increase community involvement and empowerment strategies through EcoHealth-style dengue prevention strategies, to promote improved health education and community participation around vector-borne disease prevention and control</td>
<td><strong>Positive impacts/benefits</strong>&lt;br&gt;Successful of the proposed program in the region may act as a model for other dengue endemic regions in the country, may also further the emerging agenda for EcoHealth-style vector-borne disease prevention programs in Ecuador, may improve political capital of SNEM within MoH&lt;br&gt;&lt;br&gt;<strong>Negative impacts/costs</strong>&lt;br&gt;Increased expenditure in order to scale-up the program to the full regional and then multi-regional levels would be required for new skilled human resources, training and restructuring of routine dengue prevention and control activities. New policies will have to be introduced to support the new program&lt;br&gt;&lt;br&gt;<strong>Net impact</strong>&lt;br&gt;Increased initial investment in human resources, training and policy changes could serve to improve intersectoral collaboration and communication for long-term planning, and sustainable program institutionalization.</td>
</tr>
<tr>
<td>Acting SNEM Regional Director</td>
<td>As above for SNEM; specifically targeting the eco-bio-social determinants of dengue transmission within Machala; intersectoral collaboration and community-based control efforts to enable prevention and control strategies to benefit more Machalans</td>
<td><strong>Positive impacts/benefits</strong>&lt;br&gt;As above for SNEM; Increased intersectoral collaboration on dengue prevention and control programming would provide a model platform to deal with other vector-borne diseases in the region (i.e. leishmaniasis, Chagas’ disease, malaria)&lt;br&gt;&lt;br&gt;<strong>Negative impacts/costs</strong>&lt;br&gt;As above for SNEM; may have to advocate for increased funding with Regional Director in order to scale-up the program; initial increased workload for the Regional Director may detract from other SNEM prevention, control and education programs&lt;br&gt;&lt;br&gt;<strong>Net impact</strong>&lt;br&gt;Successful implementation of program changes for EcoHealth style dengue prevention may help to mobilize communities; this may lead to improved prevention for other diseases and a cascading paradigm shift away from vertical strategy</td>
</tr>
<tr>
<td>Provincial Director, Ministry of Education</td>
<td>To participate in health education for children as part of an interdisciplinary, intersectoral, multi-stakeholder approach to promoting healthy behaviours in Machalan youth</td>
<td><strong>Expected impacts of proposed project/programme</strong>&lt;br&gt;School-based community education and empowerment programs improve student health, community health and community engagement in scholastic activities within the home; program should deepen the collaborative relationship with MoH&lt;br&gt;&lt;br&gt;<strong>Class time devoted to dengue education will be allocated from other subject areas, changes in emphasized curriculum will have to be accommodated by schools and individual instructors. Practical learning may require more resources</strong>&lt;br&gt;&lt;br&gt;<strong>Net impact</strong>&lt;br&gt;Student empowerment, health education and practical education will contribute to student health and may serve to strengthen practical links between the Ministry of Education and participant neighbourhoods</td>
</tr>
<tr>
<td>Neighbourhood Schools</td>
<td>To act as a resource and focal point of community health education and action, promoting healthy behaviours in Machalan youth</td>
<td><strong>Expected impacts of proposed project/programme</strong>&lt;br&gt;Schools are empowered to take an active role in community health, strengthening links with children, families, neighbourhood councils, Health Sub-Centres and SNEM; student health may be improved&lt;br&gt;&lt;br&gt;<strong>Expected impacts of proposed project/programme</strong>&lt;br&gt;Changes in curriculum will have to be accommodated by individual teachers and schools in general; practical lessons outside the classroom requiring more resources and time may detract from other classes&lt;br&gt;&lt;br&gt;<strong>Net impact</strong>&lt;br&gt;Strengthened relationships with families and neighbourhood councils, and intersectoral collaboration may contribute to advocacy potential of schools on community issues and community health may improve</td>
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<tr>
<td>Federal Deputy-Minister of Environment (FDMoE)</td>
<td>To support, encourage and catalyze research and development regarding the effects of climate change on ecosystem and human health in Ecuador; engaging with the strong focus on research and interdisciplinary/intersectoral programming in Machala and use dengue as a lens to examine climate change</td>
</tr>
<tr>
<td>Municipal Government City of Machala</td>
<td>To support healthy communities through basic infrastructure and sanitation services as well as special community health initiatives (i.e. <em>ningsas</em> or community clean-up events) with human resources and equipment; To hear and respond to the needs of communities as resources allow, to operate within the financial constrains of the Municipal budget</td>
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<tr>
<td><strong>Mayor</strong></td>
<td></td>
<td></td>
<td>As above for Municipal Government; decreased dengue incidence and increased political visibility with a successful program may build social capital for re-election amidst public-works controversy. Improved relationships between the Municipality, MoH and SNEM may improve resource and responsibility sharing, allowing better leverage of the Municipal Health budget for dengue</td>
<td>As above for Municipal Government; the underlying issue of provision of basic services will remain as major concerns for residents and may be emphasized through the proposed dengue prevention program. Health by-law enforcement will also be raised as an issue; enforcement will represent a financial burden for the municipality, non-enforcement would further damage the relationship between the Mayor's office and communities</td>
<td>As above for Municipal Government; Showing successful participation in the proposed dengue prevention program will likely improve relationships with MoH and communities. Increased demand on Municipality to improve basic services, policing and by-law enforcement could be politically sensitive given the tight budget.</td>
</tr>
<tr>
<td><strong>Deputy Mayor</strong></td>
<td></td>
<td>To reduce the number of Machalans living without basic services and infrastructure, to reduce demand on Municipal resources, to partner with MoH and other actors in order to support efforts to reduce dengue incidence with minimal financial involvement</td>
<td>Increased community ownership of dengue prevention and control activities may also increase community autonomy and organization. &quot;Organized&quot; communities are easier to work with, may help to facilitate needs assessments for services and infrastructure. Increased intersectoral collaboration may reduce financial and human resource burden.</td>
<td>Proposed dengue prevention and control interventions require intersectoral collaboration. As identified by other actors, the role for the Municipal Government would be to provide basic infrastructure and services to communities, a huge financial burden over a long-term (50 years) timeline. Enforcement of health by-laws and community policing will also place a financial demand on the Municipality.</td>
<td>Municipal involvement with the successful implementation of the proposed community-based dengue prevention program would increase social and political capital for the Municipality and improve relationship with communities. However, the bulk of the responsibility of the Municipality is to improve basic services on a thin budget, which will not be improved by the dengue program. This may reflect negatively on the Municipality.</td>
</tr>
<tr>
<td><strong>Municipal Health Minister</strong></td>
<td></td>
<td>To increase the capacity of the Municipality's dengue prevention and control program from seasonal activities to permanent services</td>
<td>Reduced insecticide and increased community involvement, and a potential decrease in program costs may allow the Municipality to support inexpensive year-round programming. Increased intersectoral collaboration may reduce financial and human resource burden</td>
<td>Proposed dengue prevention programs require increased skilled human resource capacity, for which the Municipal Government does not have a budget. Enforcement of health by-laws will also place a financial demand on the Municipality.</td>
<td>The successful proposed dengue prevention and control program may allow for Municipal dengue prevention and control activities to be extended to a year-round program without significant cost increases.</td>
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<tr>
<td>Provincial Council</td>
<td>To respond to community needs with available resources and to act as the community's voice in Municipal, Regional and Provincial political processes. To advocate for better infrastructure and services.</td>
<td>Strengthened relationships with Ministries and Municipality may increase access to political decision-making processes; community empowerment may improve dengue prevention and positively impact other health efforts</td>
<td>Assisting with and supporting the coordination of community meetings, training workshops and follow-up evaluation processes will require human resources often outside normal working hours to accommodate community attendees</td>
<td>Short-term investment of time and human resources may lead to decreased Aedes indices, decreased use of chemical mosquito control, improved community ownership of health programming and improved access to political decision-making on behalf of the community</td>
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<tr>
<td><strong>Local Governments</strong></td>
<td>To respond to community needs with available resources and to act as the community's voice in Municipal, Regional and Provincial political processes. To advocate for better infrastructure and services.</td>
<td>Strengthened relationships with Ministries, Municipality and Neighbourhood Councils/Presidents may facilitate participatory decision-making and program development to address infrastructure and services weaknesses throughout Machala</td>
<td>Assisting with and supporting the coordination of community meetings, training workshops and follow-up evaluation processes will require human resources often outside normal working hours to accommodate community attendees</td>
<td>Short-term investment of time and human resources may lead to decreased Aedes indices, decreased use of chemical mosquito control, improved community ownership of health programming and improved access to political decision-making on behalf of the community</td>
</tr>
<tr>
<td><strong>Community / Government Neighbourhood Councils/ Presidents</strong></td>
<td>To respond to community needs with available resources and to act as the community's voice in Municipal, Regional and Provincial political processes. To liaise with the TDR-EBS-LAC team and to facilitate community participation and knowledge sharing in the evidence generation process.</td>
<td>Strengthened presence within their own communities and strengthened relationships with other Neighbourhood Councils, Ministries, Municipality and Juntas Parroquiales may facilitate participatory decision-making and program development to address infrastructure and services weaknesses throughout Machala</td>
<td>Assisting with and supporting the coordination of community meetings, training workshops and follow-up evaluation processes will require human resources often outside normal working hours to accommodate community attendees</td>
<td>Short-term investment of time and human resources may lead to decreased Aedes indices, decreased use of chemical mosquito control, improved community ownership of health programming and improved access to political decision-making on behalf of the community</td>
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<td><strong>Community</strong></td>
<td><strong>Main objectives of stakeholder</strong></td>
</tr>
<tr>
<td>Communities</td>
<td>To participate in the evidence generation process with the goal of decreased dengue incidence and <em>Aedes</em> indices, improved community well-being and strengthened relationships with Ministry, Local and Municipal officials leading to better service provision and basic infrastructure</td>
</tr>
<tr>
<td><strong>Research</strong></td>
<td><strong>Main objectives of stakeholder</strong></td>
</tr>
<tr>
<td>Universidad Andina Simón Bolívar (UASB)</td>
<td>To build research capacity within the Eco-Health Community of practice in Latin America and support research and development with respect to Social Determination of Human Health, the social determinants of health and critical epidemiology. To improve human health through the promotion of and work within these conceptual frameworks.</td>
</tr>
<tr>
<td>University of British Columbia (UBC)</td>
<td>To build research capacity within the Eco-Health Community of practice in Latin America and Canada, to improve human health through participatory action research on critical community-identified issues</td>
</tr>
</tbody>
</table>
### Appendix 4.2 cont’d - Analysis table for stakeholder motivations and impacts of the proposed community-based dengue prevention and control program

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
<th>Expected impacts of proposed project/programme</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Research</strong></td>
<td></td>
</tr>
<tr>
<td>Universidad Técnica de Machala (UTM)</td>
<td>To increase research and development capacity in the City of Machala and the Province of El Oro, and improve human health through addressing environmental and community health issues. Provides students with opportunities to do field research and to learn and work within the EcoHealth paradigm, strengthened relationship with UASB, UBC, MoH and SNEM. Allowing for researcher time as an in-kind contribution, granting credit to students for field work done on TDR-EBS-LAC project as a practicum. Strengthened relationships with Andean and international research institutions increases UTM’s capacity for research and development work in El Oro.</td>
</tr>
<tr>
<td><strong>Private Sector</strong></td>
<td></td>
</tr>
<tr>
<td>Triple Oro Water Utility</td>
<td>To build sanitary infrastructure of piped water and sewers in order to deliver basic services to Machalans. The bitter conflict between the Municipal Government and Triple Oro, as well as conflict with communities, is pushing Triple Oro to improve its image in order to keep its contract with the Municipality. A legal battle and conflict with Provincial and National actors threatens Triple Oro’s existence in Machala. Successful involvement in the proposed dengue prevention and control program could significantly improve Triple Oro’s relationships with the 20 neighbourhoods involved, as well as with the Municipal Government, SNEM and MoH. With improved relationships, there is hope of more security. Involvement in the proposed dengue prevention and control project may expose Triple Oro to even more bitter criticism and political action. There is a focus on the social determination of health, which draws attention to political and socio-economic bias in delivery of services and infrastructure, as well as a social justice element of provision of basic services as part of the right to health, which falls under the responsibility of Triple Oro. Strengthened relationships with all government entities and with communities will be important for Triple Oro’s security and maintenance of their contract with the Municipal Government. Although essential, these strengthened relationships may stress the utility in pushing for more services in a shorter period of time, and may serve to reduce Triple Oro’s autonomy in decision-making in order to maintain these relationships.</td>
</tr>
</tbody>
</table>
### Appendix 4.3 Policy-impact stakeholder analysis tables

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
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<th>Options/ways forward</th>
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<tbody>
<tr>
<td><strong>Ministry of Health (MoH)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To improve health indicators and services while maximizing constrained health budgets. Current Health Minister has a strong interest in pursuing EcoHealth style interventions and supports a shift toward critical epidemiology</td>
<td>Top decision-maker within the National Ministry of Health; can mobilize resources, personnel and facilitate paradigmatic shifts in policy and programming. Is constrained by the President's office and can only act within the jurisdiction of the MoH.</td>
<td>High potential for positive support of current proposed program and its scale-up to wider geopolitical levels. Has demonstrated political will through participation in meetings, events and sending delegates to community partnership workshops.</td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To improve health indicators and services while maximizing constrained health budgets operate within the mandate of the Nat MoH while addressing provincial health priorities. To strengthen collaboration between provincial ministries visibly impact MoH programs</td>
<td>Top decision-maker within the Ministry of Health at the Provincial level, beholden to the National Health Minister for reporting on current programs/initiatives and operates according to strategies mandated by National MoH.</td>
<td>High potential for active support of current proposed program and its scale-up at the provincial level. Has demonstrated political will and support for the project through participating in meetings, interviews, community events and coordination with the regional SNEM office.</td>
</tr>
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### Appendix 4.3 cont’d – Policy-impact stakeholder analysis tables

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<tr>
<td><strong>Health Area (MoH)</strong></td>
<td>To improve health indicators and services in Machala; streamlining use of resources and increasing effectiveness of preventive and primary health care programs through education, health promotion and promoting health literacy.</td>
<td>Director of the Health Area has some lateral decision-making power at the local level; this is imperative to the health centres and functionaries participation in the project and proposed program, will be imperative to evaluation and implementation during scale-up process.</td>
<td>High potential for active support of current proposed program and its scale-up to the full Machala Area level and beyond; this is demonstrated by active involvement and support of project activities and active interest in supporting the evaluation and policy-making process to reflect local experiences.</td>
<td>Health areas are interested in increasing community investment in preventive health and health literacy to reduce disease and other health burdens in Machala. Success with the proposed program could lead to a shift in programming for dengue and other diseases, and strengthen partnerships with communities.</td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td>To improve community health through service delivery, addressing social and environmental determinants of health, and to promote health literacy and community participation through the service-delivery interface. To increase resources available for program implementation.</td>
<td>Marginal decision-making power, health centres operate under the mandates decided at the regional, provincial and national levels. Main source of data collection and reporting; through reporting bias can act as gatekeepers of qualitative and experiential knowledge for decision-makers.</td>
<td>High potential for active support of current proposed program and its scale-up if it serves to streamline excessive workloads and improve relationships with both decision-makers and communities.</td>
<td>Partnership with all involved MoH entities, close partnership with SNEM and the Provincial Ministry of Education office. Trust relationship with communities, but with frequent frustration over lack of resources for adequate and timely service delivery.</td>
</tr>
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<tr>
<td><strong>Health Sub-Centres (MoH)</strong></td>
<td><strong>Main interest</strong> To improve community health through service delivery, social and environmental determinants of health, and to promote health literacy and community participation through the service-delivery interface. To increase resources available for program implementation</td>
<td><strong>Power</strong> Marginal decision-making power, health centres operate under the mandates of regional, provincial and national MoH. Main source of data collection and reporting; through reporting bias can act as gatekeepers of qualitative and experiential knowledge for decision-makers</td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td><strong>Main interest</strong> To track dengue incidence and entomological indices and predict future outbreaks as part of dengue prevention and control. Interested in improving predictability and improving information systems as a preventive health measure; timely communication is essential to outbreak prevention</td>
<td><strong>Power</strong> The decision-maker at the provincial level for focus, day-to-day programs and instrumental in advocating for improved communication between actors and improved information systems. Follows the mandate of the Nat. Dept. of Epidemiology for information sharing and system structure</td>
</tr>
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<td><strong>Government</strong></td>
<td><strong>Main interest</strong></td>
</tr>
<tr>
<td>National vector-borne disease control service (SNEM)</td>
<td>To reduce dengue incidence and transmission risk through the control of insect vectors while reducing the use of chemical insecticides and increasing active community participation in dengue prevention and control programs</td>
</tr>
<tr>
<td>SNEM National Director</td>
<td>To promote the EBS/EcoHealth approach to vector-borne disease control within the mandate of SNEM. To ensure that resources are used prudently and service coverage is maximized, as well as working to strengthen relationships with communities and SNEM entities and workers</td>
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<tr>
<td><strong>Government</strong></td>
<td>To improve child, family and community health through preventive health education programs and child and family empowerment through intersectoral collaboration with the Ministry of Health at all levels</td>
<td>Decision-maker at the provincial level regarding policy and programming, is under the mandate of the National Education Minister. Can actively pursue and construct intersectoral partnerships and formalized agreements with other ministries and other sectors</td>
<td>High potential for support of successful educational elements to proposed prevention program; interested in establishing relationships between schools and neighbourhood health centres, interested in health and environmental advocacy through child and youth education</td>
<td>Strong relationship with Provincial MoH, National and regional SNEM, other MoEd actors and communities. Strong record of intersectoral collaboration with MoH, SNEM and others.</td>
<td>Good support for the scale-up of educational component of proposed programs, may serve as a model for engaging the Municipality, police, private water utility and others in intersectoral collaboration. Positive facilitator of process change with equitable family/community participation</td>
<td>Important to involve teachers in the evaluation, follow-up and scale-up process. Education-specific aspects are missing from evaluation matrix due to timing of implementation; this should be addressed before evaluation and policy development process begins.</td>
</tr>
<tr>
<td>** acting SNEM Regional Director**</td>
<td>To improve regional-level vector-borne disease prevention and control services, to engage communities and other stakeholders in collaborative programs, promote environmental conservation and the EBS/EcoHealth approaches to human health</td>
<td>Decision-maker at the regional level regarding local implementatio n of programs dictated by policy at the National level, main coordinator of intersectoral activity as it pertains to dengue prevention and control in Machala</td>
<td>Very high potential support for scaling-up of the proposed program to the regional level, vested interest in promoting the EBS/EcoHealth approaches to dengue prevention and control, excellent potential for supporting equitable community participation</td>
<td>Strong relationship with communities through past and current dengue prevention and control activities, strong partnership with MoH, Dept. Epi; partnership with Municipality and private water utility, good rapport with national and environmental police</td>
<td>Main coordinator of local and regional-level programming, as such, will likely be the main source of entomological and community-based information for the evaluation, follow-up and scale-up process. An excellent support for equitable community participation</td>
<td>As above for National SNEM Director; crucial to support collaboration with the Municipality, researchers and community members. Could serve as a facilitator of inclusion of multiple knowledge types in the evaluation process, and a bridge between actors in conflict</td>
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<tr>
<td><strong>Neighbourhood Schools</strong></td>
<td>To improve child health through education and empowerment, to provide age- and stage-appropriate tools to children and families to achieve better educational and health outcomes through partnership with communities</td>
<td>Main interface for children and families regarding preventive health education and empowerment programs, can influence implementation, evaluation and scale-up process by engaging with communities</td>
<td>High potential for support of successful educational and empowerment strategies in the proposed prevention program; excellent candidate for qualitative data and experiential knowledge collection and synthesis with families</td>
<td>Strong relationships with communities and regional/local SNEM, strong partnership with other MoEd, and MoH actors. Varied relationships with neighbourhood governments and Municipality</td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td>To improve the understanding and surveillance around climate change and effects on human health as it relates to environmental risks and determinants, to improve information sharing regarding environmental determinants of health, to explore dengue as a forum for understanding human adaptation to climate change and climate stress</td>
<td>National-level decision-maker for climate change and health initiatives, main collaborator and influential decision-maker for INHAMi, a multi-sectoral initiative to explore climate change and health in Ecuador</td>
<td>High potential for support of the proposed prevention and control program, excellent advocate for the improvement of current information systems and development of new ways of collecting, valuing, synthesizing and use of information for intersectoral collaboration and program/policy innovation</td>
<td>Strong partnership with National MoH, National SNEM, UASB and with the EBS-Ecuador project. No relationship with the Municipality of Machala. In conjunction with UASB, Provincial Dept. of Epidemiology, National SNEM and UBC, will be instrumental in developing policy around new information systems and intersectoral collaboration; strong impact on considerations for scaling-up to a provincial level through climatological mapping and GIS information sharing</td>
</tr>
<tr>
<td><strong>Federal Deputy-Minister of Environment (FDMoE)</strong></td>
<td>To improve the understanding and surveillance around climate change and effects on human health as it relates to environmental risks and determinants, to improve information sharing regarding environmental determinants of health, to explore dengue as a forum for understanding human adaptation to climate change and climate stress</td>
<td>National-level decision-maker for climate change and health initiatives, main collaborator and influential decision-maker for INHAMi, a multi-sectoral initiative to explore climate change and health in Ecuador</td>
<td>High potential for support of the proposed prevention and control program, excellent advocate for the improvement of current information systems and development of new ways of collecting, valuing, synthesizing and use of information for intersectoral collaboration and program/policy innovation</td>
<td>Strong partnership with National MoH, National SNEM, UASB and with the EBS-Ecuador project. No relationship with the Municipality of Machala. In conjunction with UASB, Provincial Dept. of Epidemiology, National SNEM and UBC, will be instrumental in developing policy around new information systems and intersectoral collaboration; strong impact on considerations for scaling-up to a provincial level through climatological mapping and GIS information sharing</td>
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<tr>
<td><strong>Government</strong></td>
<td>To improve Municipal Services and infrastructure within a restricted budget and to collaborate wherever possible with community engagement endeavours to improve well-being.</td>
<td>Good partnership with National and regional SNEM, partnership with local MoH. Varied partnership/conflict with communities and local governments, conflict with the private water utility. Good relationship with TDR-EBS project through National SNEM director and international coordinator, good potential for collaboration with UTM and UASB through project activities.</td>
<td>May have high impact on info systems and determinants of dengue risk through increased epidemiological information sharing, improved planning with private water utility and increased development of peri-urban communities. Coordination of municipal dengue prevention services with MoH could have significant impact on program institutionalization and scale-up. Important to engage the mayor’s office (deputy mayor) throughout the evaluation, follow-up and policy development stages with particular attention to basic services and information systems. Framing dengue prevention policy as a “window” through which other health problems can be addressed and political/social capital be gained may be advantageous to support intersectoral collaboration with other actors in the network.</td>
</tr>
<tr>
<td><strong>Municipal Government City of Machala</strong></td>
<td>Decision-maker at the civic level for development and planning for the City of Machala, main entity for the coordination of public works and sanitary infrastructure for the city, oversees intersectoral collaboration through the mayoral offices as well as municipal health, public works, environment and education departments.</td>
<td>Good potential for political support of results sharing and evaluation processes, moderate potential for integration of successful elements of proposed program for policy; weak short-term potential (may increase) for better dengue index monitoring through primary care and for info systems development sharing.</td>
<td>Important to engage the mayor’s office (deputy mayor) throughout the evaluation, follow-up and policy development stages with particular attention to basic services and information systems. Framing dengue prevention policy as a “window” through which other health problems can be addressed and political/social capital be gained may be advantageous to support intersectoral collaboration with other actors in the network.</td>
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<tr>
<td><strong>Government</strong></td>
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<td></td>
</tr>
<tr>
<td>Mayor</td>
<td>To improve Municipal Services and infrastructure within a restricted budget and to collaborate wherever possible with community engagement endeavours to improve well-being. To attract business and industry investment in Machala and to facilitate improvement of quality of life through economic growth.</td>
<td>Decision-maker at the civic level for development and planning for the City of Machala, main entity for the coordination of public works and sanitary infrastructure for the city, oversees intersectoral collaboration through the mayoral offices as well as municipal health, public works, environment and education departments</td>
<td>Good potential for political support of results sharing and evaluation, moderate potential for integration of successful elements of the proposed program into municipal policy and departmental programs; weak short-term potential (may increase in the long-term) for increased monitoring of dengue indices through primary care and contribution to information systems development and information sharing.</td>
<td>As above for Municipal Government City of Machala; Mayor Falquez, however, is not the holder of many of the functional relationships mentioned above for the municipality. The Deputy-Mayor is the functional representative for the mayor's office in the relationship with SNEM, local governments, communities and MoH, while the Mayor is the political representative.</td>
<td>Could have significant impact on information systems and environmental and social determinants of dengue risk through increased epidemiological information sharing, improved planning with private water utility and increased development of peri-urban communities. Coordination of municipal dengue prevention services with MoH could have significant impact on program institutionalization and scale-up</td>
<td>Important to engage the mayor's office (deputy mayor) throughout the evaluation, follow-up and policy development stages with particular attention to basic services and information systems. Framing dengue prevention policy as a &quot;window&quot; through which other health problems can be addressed and political/social capital be gained may be advantageous to support intersectoral collaboration with other actors in the network</td>
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<tbody>
<tr>
<td>Government Deputy Mayor</td>
<td>To cultivate collaborative relationships with communities, other governmental agencies and non-governmental agencies to improve access to services and infrastructure while maximizing a restrictive budget. Keenly interested in improving child health and welfare indicators through social programs and community empowerment.</td>
<td>Active decision-maker and advisor to the Mayor at the civic level for development and planning, social programs, health programs and connecting with Parish Boards and Neighbourhood Councils regarding their concerns. Primary coordinator between these disparate groups and activities, although mobilization of resources and personnel is often restricted financially, logistically, as well as politically. Can influence by-law enforcement</td>
<td>Good potential for political support of results sharing, evaluation process and advocating for deeper collaboration during the follow-up, scale-up and development of policy recommendations.</td>
<td>Partnership with MoH and SNEM National and Regional offices, strong conflict with private water utility, mixed relationships with communities and local governments. Relatively little connection with the Provincial Director of Health and Provincial Department of Epidemiology; although is open to innovative partnerships</td>
<td>Could have significant impact on information systems and environmental and social determinants of dengue risk through increased epidemiological information sharing, improved planning with private water utility and increased development of peri-urban communities. Coordination of municipal dengue prevention services with MoH could have significant impact on program institutionalization and scale-up</td>
<td>Important to engage Deputy Mayor throughout the evaluation, follow-up and policy development stages with particular attention to basic services and information systems. Framing dengue prevention policy as a “window” through which other health problems can be addressed and political/social capital be gained may be advantageous to support intersectoral collaboration with other actors in the network</td>
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<tr>
<td><strong>Municipal Health Minister</strong></td>
<td>To maximize the effectiveness of Municipal Health services through clinics, ambulatory clinics, hospitals and community health brigades and events. Very interested in expanding dengue prevention and control services from a seasonal program to constant, year-round program and to move away from reliance on pesticide.</td>
<td>Important to engage Municipal Health throughout the evaluation, follow-up and policy development stages with particular attention to basic services and information systems. Framing dengue prevention policy as a “window” through which other health problems can be addressed and political/social capital be gained may be advantageous to support intersectoral collaboration with other actors in the network.</td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td>Decision-maker for the Municipal Health Department within the confines of the budget set out by the Municipal Government and within the mandate of his department. Can influence implementation of programs and policy development, can influence the health commissioner and by-law enforcement.</td>
<td>Could have significant impact on information systems and environmental and social determinants of dengue risk through increased epidemiological information sharing, improved planning with private water utility and increased development of peri-urban communities. Coordination of municipal dengue prevention services with MoH could have significant impact on program institutionalization and scale-up.</td>
</tr>
<tr>
<td><strong>Provincial Council</strong></td>
<td>The council was unavailable for comment at the time of data collection</td>
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<tr>
<td></td>
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<td><strong>Local Governments</strong></td>
<td><strong>Main interest</strong></td>
<td><strong>Power</strong></td>
</tr>
<tr>
<td></td>
<td><strong>To improve neighbourhood security, health indicators, community empowerment, equitable access to process in the research-to-policy cycle, to improve basic services and sanitary infrastructure in their neighbourhoods; to improve community well-being and prosperity</strong></td>
<td><strong>To organize community members according to identified needs, to coordinate community efforts and initiate political action and petition for services and development on behalf of their communities. Very little decision-making power beyond their immediate jurisdiction</strong></td>
</tr>
<tr>
<td><strong>Community / Government</strong></td>
<td><strong>To respond to community needs with available resources and to act as the community’s voice in Municipal, Regional and Provincial political processes. To advocate for better infrastructure and services, and coordinate community action at the Parish level</strong></td>
<td><strong>Can make decisions regarding Parish organization and support of implementation of programs, can organize neighbourhood efforts and petitions, and in turn petition other governmental authorities on behalf of the Parish or sections of the Parish</strong></td>
</tr>
<tr>
<td><strong>Juntas Parroquiales</strong></td>
<td><strong>To organize community members according to identified needs, to coordinate community efforts and initiate political action and petition for services and development on behalf of their communities.</strong></td>
<td><strong>Excellent potential for support in the research-to-policy process, particularly within the frame of improving community health and security through the use of EBS/EcoHealth and Social Determination approaches for participatory dengue prevention</strong></td>
</tr>
</tbody>
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<tbody>
<tr>
<td>Community/Government</td>
<td>To respond to community needs with available resources and to act as the community’s voice in Municipal, Regional and Provincial political processes. To advocate for better infrastructure and services. To liaise with the TDR-EBS-LAC team and to facilitate community participation and knowledge sharing in the evidence generation process.</td>
<td>Can facilitate organization and mobilization of community members and community groups to achieve goals associated with EBS-determinants of dengue transmission risk; can synthesize opinions/voice of the community and communicate/advocate with other stakeholders, can coordinate collaborative centres within the community; primary source of knowledge</td>
<td>Varies for each neighbourhood; positive potential would strengthen community empowerment and mobilization based on self-identified priorities; negative potential would hinder participatory process through non-participation of official leadership that may serve to suppress organic community mobilization efforts</td>
<td>Mixed partnership/conflict with neighbourhood; some communities are well-represented, others not. Mixed conflict with Municipality, private water utility and other service providers; general trend of partnership with SNEM and MoH sub-centres, with periodic tension around seasonally high <em>Aedes</em> indices. Open to partnership with researchers</td>
<td>Active, equitable participation of community members is instrumental in the reshaping of information systems, evaluation strategies and for the research-to-policy process of the TDR-EBS project; this participation may also serve to improve the breadth of connections to other stakeholders and increase community mobilization for self-identified concerns.</td>
<td>Neighbourhood councils should partner with local governments and researchers to form the core facilitators of intersectoral space and collaboration; neighbourhood councils and communities should be involved in evaluation of process as well as evaluation of programs to identify equity sinks and exclusionary practices by authorities, researchers and the private sector</td>
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<tr>
<td>Community</td>
<td>To influence their health programming to address their self-identified priorities, to have equitable participation and access to the policy process, to have a voice in program design and the research-to-policy process, to promote a holistic concept of health including ecological, social, political and cultural determinants of health, to improve the quality of everyday lives of communities</td>
<td>Varies for each: positive potential empowers communities based on self-identified priorities; negative reduces participation through social resentment and apathy cycles. High participant retention rates and social analysis for the TDR-EBS project indicate that communities are interested and invested in reducing dengue transmission risk.</td>
<td>Mixed partnership/conflict with neighbourhood councils and parish boards; Mixed conflict with Municipality, private water utility; general trend of partnership with SNEM and MoH sub-centres, with periodic tension around seasonally high Aedes indices. Open to partnership with researcher, partnerships between residents and community groups. Mistrust of some government agencies and functionaries</td>
<td>Active, equitable participation of community members is instrumental in the reshaping of information systems, evaluation strategies and for the research-to-policy process of the TDR-EBS project; this participation may also serve to improve the breadth of connections to other stakeholders and increase community mobilization for self-identified concerns.</td>
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<tr>
<td>To influence their health programming to address their self-identified priorities, to have equitable participation and access to the policy process, to have a voice in program design and the research-to-policy process, to promote a holistic concept of health including ecological, social, political and cultural determinants of health, to improve the quality of everyday lives of communities</td>
<td>Negligible to non-existent decision-making power for program and policy development; exercises power to participate in accessible elements of existing programs; can coordinate, organize and mobilize around self-identified priorities; petition for better services and conditions through their local governments and community groups</td>
<td>Varies for each: positive potential empowers communities based on self-identified priorities; negative reduces participation through social resentment and apathy cycles. High participant retention rates and social analysis for the TDR-EBS project indicate that communities are interested and invested in reducing dengue transmission risk.</td>
</tr>
</tbody>
</table>
## Stakeholder power analysis of dengue prevention and control policy in Machala

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
<th>Main interest</th>
<th>Power</th>
<th>Potential</th>
<th>Relationships with others</th>
<th>Net impact</th>
<th>Options/ways forward</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universidad Andina Simón Bolívar (UASB)</td>
<td>To build research capacity within the Eco-Health Community of practice in Latin America and support research and development with respect to Social Determination of Human Health, the social determinants of health and critical epidemiology. To improve human health through the promotion of and work within these conceptual frameworks. To improve health information systems and health indicators in Ecuador.</td>
<td>No official decision-making power for policy-making, however, very prestigious influence over contemporary Ecuadorian epidemiology, and strong political influence as emphasized with participation in the construction of the 2008 Ecuadorian Constitution. Top decision-maker for TDR-EBS project.</td>
<td>Excellent potential for facilitating national-level ministers' participation in the research-to-policy process, excellent potential for influencing the development of new tools regarding social determination of health as well as developing new information systems to accommodate different knowledge valuation schemes and equitable community participation.</td>
<td>Partnership with MoH, SNEM and the TDR-EBS project; partnership with communities in the project through the TDR-EBS Machala team. Some conflict with administration and project functionaries; excellent relationship with UBC, UTMD and core research team.</td>
<td>UASB, in partnership with UBC and the SNEM Machala team, will be instrumental in promoting the evaluation, follow-up, policy development and scale-up process of the TDR-EBS project; will spearhead and mobilize resources for the development of new information systems and evaluation strategies for the scale-up process.</td>
<td>UASB must partner more closely with UTM and communities in order to create a resilient intersectoral space to support the research-to-policy process and the program refinement and follow-up strategies required to increase the responsiveness of dengue prevention and control programming; should act as a partnership facilitator along with local governments for intersectoral collaboration within tense relationships.</td>
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Appendix 4.3 cont’d – Policy-impact stakeholder analysis tables

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
<th>Stakeholder power analysis of dengue prevention and control policy in Machala</th>
<th>Options/ways forward</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Research</strong> University of British Columbia (UBC)</td>
<td>To build research capacity within the Eco-Health Community of practice in Latin America and Canada, to improve human health through participatory action research on critical community-identified issues; to facilitate an equitable research-to-policy process that reflects and responds to the local context and that is driven by communities</td>
<td>UBC must partner more closely with UTM and communities in order to create a resilient intersectoral space to support the research-to-policy process and the program refinement and follow-up strategies required to increase the responsiveness of dengue prevention and control programming; should act as a partnership facilitator along with local governments for intersectoral collaboration within tense relationships</td>
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<tr>
<td></td>
<td>To such research, strong influence, in partnership with UASB and SNEM Machala team, over the research-to-policy process and implementation of proposed programs. Can facilitate international collaboration</td>
<td></td>
</tr>
<tr>
<td>Stakeholder Group</td>
<td>Stakeholder power analysis of dengue prevention and control policy in Machala</td>
<td>Main interest</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Private Sector</td>
<td>The decision-maker for planning of the installation of basic sanitary infrastructure; in many cases this power is tied to the political will within the Municipal Government to develop infrastructure in the same targeted areas; responsible for water delivery and repair of delivery systems; major influence over determinants</td>
<td>Excellent potential for collaboration with SNEM and MoH; open collaboration with the Municipality is less likely. Very interested in and invested in community-based solutions for health issues as shown through historical record of community service and current collaboration with SNEM and MoH.</td>
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<tr>
<td>Private Sector</td>
<td>To build piped water and sewers and deliver basic services to Machalans. Bitter conflict between the Municipality and Triple Oro, conflict with communities, push to improve its image in order to keep its contract. A legal battle and conflict with Provincial and National Govt</td>
<td>The decision-maker for planning of the installation of basic sanitary infrastructure; in many cases this power is tied to the political will within the Municipal Government to develop infrastructure in the same targeted areas; responsible for water delivery and repair of delivery systems; major influence over determinants</td>
</tr>
<tr>
<td>Research Group</td>
<td>To increase research and development capacity in the City of Machala and the Province of El Oro, and improve human health through addressing environmental and community health issues</td>
<td>No official decision-making power for policy-making, however, carries a strong influence with Municipal and provincial governments; through new MOU with UBC and UASB, will have stronger influence over research-to-policy process and implementation</td>
</tr>
<tr>
<td>Universidad Técnica de Machala (UTM)</td>
<td>To increase research and development capacity in the City of Machala and the Province of El Oro, and improve human health through addressing environmental and community health issues</td>
<td>No official decision-making power for policy-making, however, carries a strong influence with Municipal and provincial governments; through new MOU with UBC and UASB, will have stronger influence over research-to-policy process and implementation</td>
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Appendix 5 – Participatory indicator glossary

Original four gross indicator categories:

Cost – encompassing the aspects of a dengue prevention and control program that carry direct economic costs for funding institutions

Efficacy – encompassing the aspects of a dengue prevention and control program that measure the impact of a dengue prevention and control intervention

Acceptability – encompassing the aspects and/or outcomes of a dengue prevention and control program that indicate the level of acceptance of the program by involved stakeholders and stakeholder groups

Sustainability – encompassing the aspects of a dengue prevention and control program that measure current and/or future sustainability of the program

Original secondary criteria grouping:

Human resources – the skilled human resource capacity needed to undertake and sustain dengue prevention and control activities; related to cost analysis

Transport – the resources needed to mobilize skilled human resources to respond to dengue prevention and control activity needs; related to cost analysis

Supplies – consumables needed for undertaking dengue prevention and control activities; related to cost analysis

Vector indices – entomological indices used for tracking presence of the dengue vector *Aedes aegypti* in communities and calculating dengue transmission risk; related to efficacy analysis
Community participation – arms length indices used for measuring evidenced participation as a measure of success; related to efficacy analysis

Epidemiological indices – population-level human health indices used to track the presence and spread of dengue fever; related to efficacy analysis

Stakeholder opinions – program elements developed to access experiential knowledge regarding dengue prevention and control programs and activities; related to acceptability analysis

Participation – action-oriented measurables pertaining to changes in ways of participating and behaving toward dengue and dengue prevention and control programs; related to acceptability analysis

Integration of program concepts into activities and norms – areas of qualitative observation relating to the change in dengue prevention and control culture; related to acceptability analysis

Human and community well-being – measurables related to the improvements of the social, environmental and political determinants of dengue transmission risk; related to acceptability analysis

Intersectoral coordination – both qualitative and quantitative observables related to the collaborative activities including actors from different sectors and stakeholder groups to address dengue prevention and control activities and programs; related to sustainability analysis

Community empowerment – qualitative observable pertaining to equitable community participation and ownership of dengue prevention and control programs and activities; related to sustainability analysis
Program institutionalization – measurables tracking continued institutional support for dengue prevention and control activities; related to sustainability analysis

Communication of results – observables regarding the use of various communication strategies for disseminating information and generating dialectic collaboration; related to sustainability analysis

Tertiary level indicators and desired directionality:

Health inspectors/promoters – number of health inspectors and promoters working on dengue prevention and control programs and total salary costs; desirable to minimize cost while maximizing human resource pool for better program coverage and quality, related to cost analysis

Vector control personnel – number of personnel working on dengue prevention and control programs and total salary costs; desirable to minimize cost while maximizing human resource pool for better program coverage and quality, related to cost analysis

Doctors and nurses – number of clinical and public health doctors and nurses working on dengue prevention and control programs and total salary costs; desirable to minimize cost while maximizing human resource pool for better program coverage and quality, related to cost analysis

Ministry of Health trucks and drivers – number and availability of vehicles and drivers to mobilize personnel to sites to undertake dengue prevention and control activities, and total cost of driver salaries, vehicles and maintenance; desirable to minimize cost while maximizing human resource pool and vehicle fleet for better program coverage and quality, related to cost analysis
Heavy transport trucks and drivers for community clean-ups - number and availability of vehicles and drivers to mobilize personnel to sites to undertake dengue prevention and control activities, and total cost of driver salaries, vehicles and maintenance; desirable to minimize cost while maximizing human resource pool and vehicle fleet for better program coverage and quality, related to cost analysis

Vector control transport - number and availability of vehicles and drivers to mobilize personnel to sites to undertake dengue prevention and control activities, and total cost of driver salaries, vehicles and maintenance; desirable to minimize cost while maximizing human resource pool and vehicle fleet for better program coverage and quality, related to cost analysis

Gasoline – the amount of financial resources dedicated to purchasing gasoline for the vehicles to enable mobilization of personnel for the purposes of undertaking dengue prevention and control activities; minimizing costs while maximizing the frequency of activities and the geographic range within which they function on a regular basis is desirable, related to cost analysis

Insecticides – the cost and amount of temephos larvicide available and used to treat vector-breeding habitat, and the cost and amount of deltamethrine adulticide available and used to fog residences and neighbourhoods using backpack and vehicle-mounted foggers; decreasing chemical use, decreasing cost, while maintaining sufficient coverage to control dengue transmission risk is desirable, related to cost analysis

Education materials – the cost, amount and availability of current, updated and appropriate literature, visual aids, models and other education materials to support dengue prevention and control education campaigns; decreasing cost while improving the quality, availability and coverage of educational materials is desirable, related to cost analysis
Community meetings: snacks and incentives – having a dedicated budget to provide snacks for community meetings and incentives for the communities who undertake ownership of dengue prevention and control programs; minimizing cost while maximizing attractiveness of snacks and incentives is desirable, related to cost analysis

Tank covers – refers to the cost and availability of any and all tools, implements and supplies provided free-of-charge to the community to directly enable them to participate in prescribed dengue prevention and control programs (for example, providing tank covers to promote residents covering their tanks); maximizing coverage and attractiveness while minimizing cost is desirable, related to cost analysis

Pupas per person index – as a measure of dengue transmission risk expressed as a proportion, calculates the number of *Aedes aegypti* pupae per person in a particular geographic or geopolitical unit based on pupal counts obtained from physical inspection of vector breeding habitat for the presence of immature stages of the vector; decreased index is desirable, related to efficacy analysis

House index – as a measure of dengue transmission risk expressed as a proportion, calculates the number of houses out of 100 inspected houses harbouring containers positive for the presence of immature *Aedes aegypti* vectors, based on pupal and larval counts obtained from physical inspection of vector breeding habitat for the presence of immature stages of the vector; decreased index is desirable, related to efficacy analysis

Typing of productive containers – as a means of calculating and communicating container-specific attributable dengue transmission risk, identification of the kinds of containers that produce the largest proportion of the immature vector population, based on pupal and larval counts obtained from
physical inspection of vector breeding habitat for the presence of immature stages of the vector; identifying and communicating the risky container types to communities is desirable, using this as a means of designing community-based interventions through equitable participation is desirable, changes in important container types may indicate effectiveness of intervention, related to efficacy analysis.

% of patios clean and organized – as an “arm’s length” means of calculating and tracking community participation, the proportion of program-targeted homes with a low-risk patio (i.e. void of larval breeding habitat, free of garbage and weeds, absence of standing water, absence of immature mosquito vectors) out of the total number of program-targeted homes; desirable to increase this proportion to reduce dengue transmission risk as measured through entomological indices and risk, related to efficacy analysis.

% of covered tanks – a proxy title for an “arm’s length” means of calculating and tracking community participation regarding the mitigation of dengue transmission risk as it pertains to large water storage containers for domestic use (i.e. ground-level tanks, elevated tanks, cisterns, large fountain-style domestic water wells), the proportion of program-targeted homes with protected large water storage containers (i.e. covered tanks, sealed and clean cisterns, capped wells) out of the total number of program-targeted homes; desirable to increase this proportion to reduce dengue transmission risk as measured through entomological indices and risk, related to efficacy analysis.

Changes in healthy behaviours – a broader “arm’s length” means of tracking community participation in domestic behaviour-change elements of participatory dengue prevention and control programs, measured as the proportion of program-targeted households exhibiting a new or changed behaviour in daily dengue risk-management domestic activities (these activities would depend on the proposed program and should reflect the priorities/issues of the
neighbourhood they are tracked within, i.e. covering tires with plastic sheets to prevent water accumulation rather than using diesel fuel to treat water within them, cutting weeds and eliminating breeding habitat in the communal areas immediately surrounding the home); desirable to increase this proportion to reduce dengue transmission risk as measured through entomological indices and risk, related to efficacy analysis

**Dengue incidence** – refers to the use of cumulative incidence, that is the risk of dengue infection over given period of time, expressed as a proportion it is the number of new dengue cases for a given period of time and geopolitical area divided by the total number of people residing within that geopolitical area; desirable to decrease this index, related to efficacy analysis

**Number of people treated** – an indirect measure related to incidence, it is the total number of people treated for dengue infection within a given period of time, in the context of Machala, this is often based on suspected dengue cases but may also reflect laboratory confirmed dengue cases; desirable to decrease this index but only as it reflects a decreasing need for treatment and not as a services provision shortage, related to efficacy analysis

**Frequency and magnitude of outbreaks and epidemics** – a population level conception of changes to epidemic transmission cycles over time in a given geographic area, in Machala decreasing the frequent small-scale outbreaks is though to have some impact in increasing the time between cyclic epidemics at the city, provincial and southern regional levels; desirable to decrease both of these indices, related to efficacy analysis

**Asking peoples opinions one-on-one at people’s homes or workplaces** – a performance/process oriented evaluation element relating to accessible process and equitable participation in dengue prevention and control programs through the in-person collection of experiential and tacit knowledge at times and places
convenient to community stakeholders to influence design, development, undertaking and evaluation of interventions, programs and policy; desirable to have multiple interfaces under this element, related to acceptability analysis.

**Communication through organized leaders** - a performance/process oriented evaluation element relating to accessible process and equitable participation in dengue prevention and control programs through intentional communication with community and/or working group leaders to incorporate experiential and tacit knowledge to influence design, development, undertaking and evaluation of interventions, programs and policy; desirable to have multiple interfaces under this element, related to acceptability analysis.

**Meetings** - a performance/process oriented evaluation element relating to accessible process and equitable participation in dengue prevention and control programs through bringing diverse stakeholders together to share knowledge and work on program elements, as the case of community meetings, to incorporate experiential and tacit knowledge to influence design, development, undertaking and evaluation of interventions, programs and policy; desirable to increase the number, frequency and access under this element, related to acceptability analysis.

**Short surveys** – a performance/process oriented evaluation element relating to accessible process and equitable participation in dengue prevention and control programs through collecting stakeholder opinions on specific program elements in a quick and more quantifiable way in times and places convenient to stakeholders to influence design, development, undertaking and evaluation of interventions, programs and policy; desirable to increase the number, frequency and access under this element, related to acceptability analysis.

**Family and community-level activities incorporate program concepts** – an evaluation element relating to changes in dengue/dengue prevention culture in
Machala through community ownership of programs, and behaviour change at the individual, family, group, and neighbourhood levels. This element should include qualitative, experiential, tacit, observational, ethnographic and contextual knowledge, and should be expressed as such rather than a yes/no or low/med/high overly simplistic approximation of a complex and rich response; desirable to have this process element present in programs and desirable to show increasingly positive engagement of communities and stakeholders to decrease dengue transmission risk and improve health equity, related to acceptability analysis.

**Rhetoric, language and educational activities incorporate program concepts** - a performance/process oriented evaluation element relating to changes in dengue/dengue prevention culture in Machala through change in dialogue and discourse involving multiple levels of all stakeholder groups and particularly centering around the effects of equitable intersectoral collaboration. This element should include qualitative, experiential, tacit, observational, ethnographic and contextual knowledge, and should be expressed as such rather than a yes/no or low/med/high overly simplistic approximation of a complex and rich response; desirable to have this process element present in programs and desirable to show increasingly positive engagement of communities and other stakeholder groups to improve health equity and equitable participation, related to acceptability analysis.

**Political will incorporates program concepts** - a performance/process oriented evaluation element relating to changes in dengue/dengue prevention culture in Machala through behaviour change within political bodies as they relate to equitable process, intersectoral spaces, governance as it pertains to dengue prevention and control, and the development of supportive policy instruments. This element should include qualitative, experiential, tacit, observational, ethnographic and contextual knowledge, and should be expressed as such rather than a yes/no or low/med/high overly simplistic approximation of a complex and
rich response; desirable to have this process element present in programs and desirable to show increasingly positive engagement of political decision-makers and other stakeholder groups to decrease dengue transmission risk and improve health equity, related to acceptability analysis

**Having adequate provision of basic services and sanitary infrastructure** - a performance/process oriented evaluation element relating to social determination of dengue transmission risk in Machala, specifically with respect to provision of piped water, roads, storm and sanitary sewers, garbage collection, and policing. This element should include qualitative, experiential, tacit, observational, ethnographic and contextual knowledge, and should be expressed as such rather than a yes/no or low/med/high overly simplistic approximation of complex social justice and human security issues; desirable to have this process element present in programs and desirable to show increasing provision of infrastructure and services in high-risk neighbourhoods to decrease dengue transmission risk and improve health equity, related to acceptability analysis

**Having community ideas and opinions considered and applied in program decision-making processes** - a performance/process oriented evaluation element relating to changes in participatory dengue prevention and control programming and decision-making in Machala (both in the context of research and development) through behaviour change within decision-making bodies (political, research, international partnerships, intersectoral spaces) as it relates to equitable process, construction and maintenance of intersectoral spaces, and the research-to-policy processes as they pertains to dengue prevention and control, and the development of supportive research and policy instruments. This element should include qualitative, experiential, tacit, observational, ethnographic and contextual knowledge, and should be expressed as such rather than a yes/no or low/med/high overly simplistic approximation of a complex dynamics; desirable to have this process element present in programs and desirable to show increasingly positive engagement of political decision-makers and other
stakeholder groups to decrease dengue transmission risk and improve health equity, related to acceptability analysis

**Improvement of the community environment, both built and natural** - a performance/process oriented evaluation element relating to social determination of dengue transmission risk in Machala, specifically with respect to community well-being as it relates to public safety and security, improvement of community spaces, lighting, buildings, greenspaces and recreation spaces. This element should include qualitative, experiential, tacit, observational, ethnographic and contextual knowledge, and should be expressed as such rather than a yes/no or low/med/high overly simplistic approximation of complex environmental, social and human security issues; desirable to have this process element present in programs and desirable to show increasing improvements in community environment and services for high-risk neighbourhoods to decrease dengue transmission risk and improve health equity, related to acceptability analysis

**Number of participating stakeholder groups** – a performance/process oriented indicator pertaining to the character and quantities of intersectoral spaces; desirable to have increased numbers and diversity of participating stakeholder groups, pertains to sustainability analysis

**Frequency of meetings, events and collaborative activities between groups** - a performance/process oriented indicator pertaining to the character and productivity of intersectoral spaces; desirable to have increased frequency, pertains to sustainability analysis

**Official agreements to collaborate** - a performance/process oriented indicator pertaining to the character of intersectoral spaces and to their sustainability as it pertains to institutionalization of intersectoral collaboration and institutional support for sustained intersectoral activity; desirable to have increasing numbers of officially recognized agreements between sectors and disciplinary silos to
collaborate on reducing dengue transmission risk and improving health equity, pertains to sustainability analysis

**Degree of program ownership within the community** - a performance/process oriented evaluation element relating to community empowerment as indicated by changes in participatory dengue prevention and control programming and decision-making in Machala (from the neighbourhood level through to governance) through increased community presence and community-driven processes for decision-making as it relates to participatory dengue prevention and control activities, programs and policy. This element should include qualitative, experiential, tacit, observational, ethnographic and contextual knowledge, and should be expressed as such rather than a yes/no or low/med/high overly simplistic approximation of a complex dynamics; desirable to have this process element present in programs and desirable to show increasingly positive engagement of political decision-makers and other stakeholder groups to decrease dengue transmission risk and improve health equity, related to sustainability analysis

**Number of new/active community groups involved in program activities** - a performance/process oriented evaluation element relating to community empowerment as indicated by community action and community-driven processes as they relates to participatory dengue prevention and control activities, programs and policy; desirable to increase this indicator, related to sustainability analysis

**Degree of community inclusion in decision-making processes related to program development, evaluation and implementation** - a performance/process oriented evaluation element relating to community empowerment as indicated by changes in participatory dengue prevention and control programming and decision-making power structures in Machala through increased community-driven processes for decision-making as it relates to
participatory dengue prevention and control activities, programs and policy. This element should include qualitative, experiential, tacit, observational, ethnographic and contextual knowledge, and should be expressed as such rather than a yes/no or low/med/high overly simplistic approximation of a complex dynamics; desirable to have this process element present in programs and desirable to show increasingly positive engagement of political decision-makers and other stakeholder groups to decrease dengue transmission risk and improve health equity, related to sustainability analysis

**Dedicated financial resources** - a performance/process oriented evaluation element relating to program institutionalization and the amounts and availability of dedicated financial resources dedicated to various program elements; desirable to increase the amount of dedicated financial resources and the diversity of program elements to which they are dedicated, related to sustainability analysis

**Implementation of recommended strategies** - a performance/process oriented evaluation element relating to changes in evidence-based dengue prevention and control programs particularly as they relate to community-based and participatory elements; This element should include qualitative, experiential, tacit, observational, ethnographic and contextual knowledge, and should be expressed as such rather than a yes/no or low/med/high overly simplistic approximation of a complex dynamics; desirable to have this process element present in programs and desirable to show increasingly positive engagement of political decision-makers and other stakeholder groups to decrease dengue transmission risk and improve health equity, related to sustainability analysis

**Constant follow-up and evaluation of program activities** - a performance/process oriented evaluation element relating to operationalizing resources to broaden the evidence base that drives processes to continuously improve evidence-based dengue prevention and control programs particularly as
they relate to community-based and participatory elements; This element should include qualitative, experiential, tacit, observational, ethnographic and contextual knowledge, and should be expressed as such rather than a yes/no or low/med/high overly simplistic approximation of a complex dynamics; desirable to have this process element present in programs and desirable to show increasingly positive engagement of political decision-makers and other stakeholder groups to decrease dengue transmission risk and improve health equity, related to sustainability analysis

**Communication via TV, radio and newspapers** – a performance/process oriented evaluation element relating to the dissemination of knowledge, information and results through media coverage of program activities and outcomes, as well as taking in knowledge and information from these sources as reported by stakeholder groups that may or may not be directly involved in the knowledge management network; desirable to use these tools to measure knowledge management and sharing strategies, and to increase their reach and effectiveness, related to sustainability analysis

**Communication via meetings and presentations** - a performance/process oriented evaluation element relating to the dissemination of knowledge, information and results through organized workshops, meetings and presentations, as well as taking in knowledge and information from these sources as reported by stakeholder groups that may or may not be directly involved in the knowledge management network; desirable to use these tools to measure knowledge management and sharing strategies, and to increase their reach and effectiveness, related to sustainability analysis

**Communication via flyers and pamphlets** - a performance/process oriented evaluation element relating to the dissemination of knowledge, information and results through printed material distributed through program activities, as well as taking in knowledge and information from these sources as reported by
stakeholder groups that may or may not be directly involved in the knowledge management network; desirable to use these tools to measure knowledge management and sharing strategies, and to increase their reach and effectiveness, related to sustainability analysis
Appendix 6 – Statistical output for principal component and hierarchical clustering analyses

Principal component analysis:

Summary Plots

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<th>Eigenvalue</th>
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<th>Percent 20 40 60 80</th>
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Hierarchical Clustering analysis:

Indicator clustering dendrogram
Respondent clustering dendrogram
Heatmap and dendrograms for clustering of indicators by respondents

Hierarchical Clustering

Method = Ward

Dendrogram