

THE MODERN NORTHWESTERN EJIDO UNDER  
MEXICAN AGRARIAN REFORM

by

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M.A. Honours, University of Glasgow, 1969

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF  
THE REQUIREMENTS FOR THE DEGREE OF  
MASTER OF ARTS

in the Department  
of  
Geography

We accept this thesis as conforming to the  
required standard

THE UNIVERSITY OF BRITISH COLUMBIA  
September, 1971

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## ABSTRACT

Mexican Land Reform, conceived during the civil war and initiated in the Revolutionary Code of 1917, is responsible for the existence today of three different farming groups. These are the particulares, the private farmers, the ejidatarios, the peasant farmers, and the colonos, the colonist farmers. This study is concerned with the relative fortunes of the three, and especially with the largest numerically, the ejidatarios. This last group has been regarded, and is still so considered, as the worst off. The plight of the ejidatarios seems to be even more acute in modernized areas according to State and national statistics. It is hypothesized here that certain aspects of the Mexican Land Reform work against the better interests of the ejidatarios, particularly in areas where modernized agricultural practices have become the norm. The hypothesis is tested in one of the agriculturally most advanced areas in all Mexico, the Río Fuerte Irrigation District of Northern Sinaloa. Within this District the performance of the Mexican ejido, peasant holding, is compared with that of the private property farm.

The comparison begins with an investigation of all cropping activities in the District, designed to establish the broad differences in performance between the ejidal and private farm groups (Chapter III). It is found:- that the ejidal sector operates its cropland less intensively than the private sector; that the ejidatarios do not compensate for their poorer resource use by obtaining crop yields and prices markedly superior to those of the private sector; and that the ejidatarios obtain a much lower gross income per hectare than the private farmers.

In the second stage of comparison, a sample of farms is taken from the most productive sub-area in the District, in order to test the hypothesis and to try to isolate the primary factors hindering the ejidal sector (Chapter IV). The farms selected

consist of the ejidal plots where wheat is cultivated in the main crop rotation; and for the purposes of comparing net incomes, wheat-growing private and colono farms are also sampled. It is found that the mean net income per hectare is much lower in the ejidal than in the other two sectors. This cannot be entirely explained by poorer quality land resources, ineptitude, lack of hybrid seed or fertilizer, or by shortage of irrigation water. Nor can it be entirely explained by its somewhat poorer overall yield. Rather is the problem found to be in the nature of the ejidatarios' credit source, the Ejidal Banks, and the operational constraints associated with that source's loan policy. It is shown that the cost of ejidal farm operation is unnecessarily high, because the ejidatarios are not permitted efficient use of their own labour resources; hired labour and machinery are supplied by the Banks to the ejidatarios to cultivate their land and these inappropriate high-cost inputs are charged within the loans given..

It is concluded that overmuch modernization is being forced upon the peasant farmers, to the ultimate detriment of their farm's viability, their personal income and living levels, and also that the hypothesis is correct:- The Agrarian Reform Laws have indeed led to operational difficulties and considerable depression of the peasant farmer's net income, though the particular credit system evolved was actually created to benefit him.



## TABLE OF CONTENTS

	Page
ABSTRACT . . . . .	i
LIST OF TABLES . . . . .	vi
LIST OF FIGURES . . . . .	x
LIST OF MAPS . . . . .	xi
ACKNOWLEDGEMENTS . . . . .	xii
Chapter	
1. INTRODUCTION . . . . .	1
<p style="padding-left: 40px;">The Mexican Land Reform and the Viability of the Modern Northwestern Ejido</p> <p style="padding-left: 40px;">Land Reform - Definitions and Process</p>	
11. THE FUERTE IRRIGATION DISTRICT: THE REGIONAL CONTEXT . . . . .	10
<p style="padding-left: 40px;">Large Scale Agro-Irrigation Development in Northwest Mexico</p> <p style="padding-left: 40px;">The Development of Irrigation and Agriculture on the Fuerte</p> <p style="padding-left: 40px;">The CRF: Organization and Aims</p> <p style="padding-left: 40px;">The Aims of the Fuerte Comision</p>	
111. THE FARM CHARACTERISTICS OF THE FUERTE SCHEME . . . . .	35
<p style="padding-left: 40px;">Main Tenure Groups, their Land Distribution and Quality</p> <p style="padding-left: 40px;">Distribution of Sown Area Among Tenure Groups</p>	

TABLE OF CONTENTS -- Continued

Chapter		Page
111.	Tenure Groups' Performance at 1st and 2nd Cultivations  Imbalances between Tenure Groups and between Units in Terms of Crop Values Generated  Problems of Explanation, Measurement and Isolation of Crucial Variables - Some Solutions  Summary of District/Unit/Zone Data for all Crops Grown and Assessment of Tenure Groups' Performances	
IV.	THE SAMPLE AREA - UNIT 2 . . . . .  The Choice of Unit 2 and Rationale for Wheat Cultivation Study  Wheat in Unit 2 and the District  The Unit 2 Tenure Groups and their Farm Holdings  The Farm Sample: The Data and Basic Findings  Mexican Agrarian Credit  Sources of Tenure Groups' Credit, Application Procedures and character- istics of Services Supplied  Operational Influences of Credit on Farming  The Effect of the Credit Programme on the Ejidatarios' Viability  Conclusions	58
V.	CONCLUSIONS AND SOME SUGGESTIONS FOR AMELIORATION OF THE PROBLEM . . . . .	105
	SELECT BIBLIOGRAPHY . . . . .	109

TABLE OF CONTENTS -- Continued

	Page
APPENDIX	
1. THE MEXICAN CONSTITUTION OF 1917 AND ARTICLES 10 & 27 . . . . .	117
2. TESTS FOR NORMALITY OF DATA BASED ON SKEWNESS AND KURTOSIS . . . . .	119
3. TESTS FOR THE SIGNIFICANCE OF DIFFERENCES BETWEEN MEANS . . . . .	121
4. LIST OF BODIES REFERRED TO IN THE TEXT AND THEIR ABBREVIATIONS . . . . .	122
5. LORENZ CURVES OF UNIT 2 WHEAT FARMS' INCOME (FIGURES 4a-d & FIGURES 5a-d) - 4a-d DISTRIBUTION OF GROSS FARM INCOMES 5a-d DISTRIBUTION OF NET FARM INCOMES . .	123

## LIST OF TABLES

Table		Page
<u>I</u>	Recipients of Land by Presidential Term, 1915-1964, Area Redistributed, 1916- 1967, & Related Presidential Policies . .	8
<u>II</u>	Irrigation Districts of the Sonoran Desert . . . . .	11
<u>III</u>	Land Area Benefited by Major Federal Irrigation Projects, 1930-58 . . . .	14
<u>IV</u>	Land Benefited by Major Federal Irrigation Projects as Percentage of Total Area Cultivated, 1939-59 . . . . .	14
<u>V</u>	Regional Construction of Paved Roads, 1935-55 . . . . .	14
<u>VI</u>	Crop Production Characteristics of the Northwest Irrigation Schemes, Mexico, 1967/68 . . . . .	19
<u>VII</u>	Allocation of Land Held by Main Tenure Types, Number of Farmers and Average Farm Size for the Principal Sonoran Desert Irrigation Areas of Mexico, 1967/68 . .	20
<u>VIII</u>	Analysis of the Agricultural Expansion of the Fuerte District, Sinaloa, 1944/45- 1969/70 . . . . .	24
<u><sup>T</sup> LXX</u>	Dimensions of Fuerte District, Units & Zones, 1969/70 . . . . .	37
<u>X</u>	Dimensions of Fuerte District, Units & Zones by Tenure Groups, 1969/70 . . . .	37
<u>XI</u>	District Farmers Grouped Property Size, 1969/70 . . . . .	40
<u>XII</u>	Average Farm Size, Gross (a) & Irrigable (b) in District, 1969/70 . . . . .	43

LIST OF TABLES -- Continued

Table		Page
<u>XIII</u>	District Farmers Grouped by Property Size for Sub-Divisions, 1979/70 . . . .	42
<u>XIV</u>	Crop Activities of District Sub-Divisions, 1969/70 . . . . .	43
<u>XV</u>	Crop Activities of District Sub-Divisions by Tenure Groups, 1969/70 . . . . .	45
<u>XVI</u>	Crop Activities of District Sub-Divisions at 1st & 2nd Cultivation Periods by Tenure Groups, 1969/70 . . . . .	46
<u>XVII</u>	Average Gross Harvest Values per Farmer for District & Sub-Divisions by Tenure Groups, 1969/70 . . . . .	48
<u>XVIII</u>	Distribution of Farms, Area Sown, & Harvest Value for District's Sub-Divisions by Tenure Groups, 1969/70 . . . . .	50
<u>XIX</u>	Sub-Divisions' Farms, Sown Area, & Harvest Values by Tenure Groups as Percentages of District with District Breakdown by Tenure Groups, 1969/70 . . . . .	50
<u>XX</u>	Indices of Land Intensity & Indices of Cultivation Efficiency for District & Sub-Divisions by Tenure Groups, 1969/70 .	52
<u>XXI</u>	Principal Crops of the Fuerte District by Descending Order of Value, 1969/70 . . .	54
<u>XXII</u>	Ejidal Crop Performance Compared to that of the Private Sector for the Major District Crops, 1969/70 . . . . .	56
<u>XXIII</u>	Indices of Total Sown Area & Harvest Value of All Crops & of Wheat for District 1964/65-1969/70 . . . . .	64

LIST OF TABLES -- Continued

Table		Page
<u>XXIV</u>	Analysis of Wheat Production of District & Sub-Divisions, 1968/69-1969/70 . . .	61
<u>XXV</u>	Analysis of Wheat Production for Districts Sub-Divisions by Tenure Groups, 1968/69- 1969/70 . . . . .	63
<u>XXVI</u>	Sub-Divisions' Wheat Areas Sown, Production & Values by Tenure Groups as Percentages of District's Tenure Group Totals, 1968/69-1969/70 . . . . .	64
<u>XXVII</u>	Sub-Divisions' Wheat Areas & Harvest Values by Tenure Groups as percentages of the District Totals, 1968/69-1969/70 . . .	66
<u>XXVIII</u>	Ejidal Wheat Crop Performance for District & Sub-Divisions Compared to that of the Private Sector, 1968/69-1969/70 . . . .	66
<u>XXIX</u>	Characteristics of the Ejidos in Unit 2, 1969/70 . . . . .	70
<u>XXX</u>	The Wheat Sample Population of Unit 2, 1969/70 . . . . .	70
<u>XXXI</u>	Tests for Normality of Unit 2 Farm Sample Data Based on Skewness & Kurtosis . . .	74
<u>XXXII</u>	Significance of the Differences between Means of Unit 2 Wheat Sample Farms, 1969/70 . . . . .	76, 78
<u>XXXIII</u>	Indexes of Evenness for Gross & Net Income of the Unit 2 Wheat Sample Farms, 1969/70	78
<u>XXXIV</u>	Correlations between Area & Yield (Private Farms only), & between Double Cropping & Yield (All Farms), of the Unit 2 Wheat Sample Farms, 1969/70 . . . . .	78

LIST OF TABLES -- Continued

Table		Page
<u>XXXV</u>	Analysis of Wheat Production on Unit 2 Sample Farms, 1969/70 . . . . .	80-81
<u>XXXVI</u>	Analysis of Farmers' Water Costs and Scheme Charges paid to CRF . . . . .	97
<u>XXXVII</u>	Family Labour Supply and its Utilization for the Unit 2 Wheat Growing Ejidatarios, 1969/70 . . . . .	99

## LIST OF FIGURES

Figure		Page
1	Internal Structure of CRF and Linkages to SRH and Other Agencies . . . . .	26
2	Organization of the CRF Sub-Areas, Indicating Main Routes of Farmer-Scheme Employee Communication . . . . .	28
3	Cycle of Demand for Water in the CRF Scheme . . . . .	30



## LIST OF MAPS

Map		Page
1.	The Main Irrigation Schemes of N.W. Mexico	13
2.	The Fuerte Irrigation District, Sinaloa	36
3.	Farm Areas Sampled in Unit 2, Fuerte District, Sinaloa . . . . .	73

## ACKNOWLEDGEMENTS

Acknowledgements are due to many individuals who helped to make the field work for this study possible. In particular thanks must be given to Ing. Abelardo Amaya Brondo, Director of Irrigation Districts within the Secretariat de Recursos Hidráulicos in Mexico City, and to Ing. Guillermo A. Fernández de Lara of the Planning Department of Ing. Amaya's directorate. This study would scarcely have materialized without the cooperation, kindness and patience of members of the Comisión Del Río Fuerte in Los Mochis, Sinaloa, among others Ing. Guillermo Blake Aguilar, Director of the Comisión, Sr. Juan de Dios Guevara, Administrative Chief, and, above all, Ing. Guillermo Macías H., Chief Engineer of the District, who gave freely of his and his staff's time, his office space, aircraft, and car, and who cheerfully and frankly assisted with search for materials and with argument. Sincere thanks are also extended to Sr. Pedro Vega, District private and ejidal farmer, and employee of the Comisión at the Unit 2 Office, without whose generous chauffeuring, hospitality and fund of farming experience I would have seen and understood only a fraction of the Fuerte scheme, to whose farmers I also owe much.

To Mike Patterson, my office mate, I owe particular thanks for the time, effort and patience with which he undertook the statistical testing on the IBM 360 for Chapter IV. Finally I should like to express my thanks to my adviser and reader Dr. A.H. Siemens and to my reader Dr. R.N. North.

CHAPTER I

## INTRODUCTION

The Mexican Land Reform and the Viability of the Modern  
Northwestern Ejido

The Mexican Land Reform, born out of the Revolutionary Code of 1917, is responsible for the present-day pattern of land holdings and for the creation of three distinctive farming groups. These three groups are the particulares or pequeñas propietarios, the private farmers, the ejidatarios or ejidal farmers, the peasant farmers, and the colonos, the colonist farmers.

The private farmer has a size limit placed on his holding normally of between 100 and 150 hectares, depending on what crops he is in the habit of cultivating.\* He owns land through purchase and hence is a landowner in a full, legal sense. The ejidatario also has a size limit on his holding, usually 10 hectares, but he has not become a landowner through purchase. He is the recipient of free land given him by the nation under the Mexican Land Reform which called for the breakup of national domain, the haciendas, large pre-revolutionary estates, and the Church land. Under the Constitution of 1917 the ejidatario can hand down his land to his eldest son, and retains his land only so long as he works it regularly; furthermore, he cannot sell his land, mortgage it, or rent it, since the land, strictly speaking, is the property of the nation. The ejidatario's land cannot therefore be used as security against a loan. The colono farmer's holding is normally around 8 to 14 hectares but the upper limit to its legal size is less clearly enunciated in the Agrarian Code than for the other two main farming groups. Under the Reform Code, provision was made

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\*See Appendix 1 for details of land unit sizes and Article 27.

for colonos to purchase land in the frontier regions of Mexico at a very low cost, the aim of the government being actively to promote colonization of the then empty states. The colono farmer, therefore, owns his land in a full legal and binding sense, unlike the ejidatario. He could be thought of as a small private farmer, but his frontier location and his normal origin, that of a central-highlands' farmer, plagued by the limited opportunities of minifundia, subdivided small-holdings, distinguish him from the particulares. In the case of Northwest Mexico, the expansion of the colono group came with the impetus given in the Federal Law of Colonization in 1946. In 1963 a revision was made to the Agrarian Code which withdrew all further public domain from being granted to colonists, and reserved its use strictly for distribution to communal ejidos (Henderson 1965, 312). Land speculation and associated re-concentration of ownership into the hands of a few large private and influential individuals, caused this revoking of the law.

Numerically dominant and central to this study and to the Reform are the campesinos or ejidatarios. Certain questions, increasingly insistent as one probes into the situation of these ejidatarios, need to be investigated:- How, for instance, are the ejidatarios of the late twentieth century reacting to the introduction of modern technology in farming? Have they operational and financial problems? Are these problems attributable in any respect to the Revolution's Reform Laws or, in other words, are the ejidatarios being hindered in carrying out farming that is most beneficial to themselves by constraints placed on and around them by the Reform? If this is so, then it could be argued that the peasant's viability as an independent agriculturalist is in jeopardy because of constraints placed on him by a reform supposedly designed to promote his livelihood through tenancy of land. Moreover, evidence exists that in spite of the Reform, reconcentration of land into a few powerful private hands is taking place in Mexico's most modernized agricultural areas, such as the Northwest where agrarian incomes are the highest in the nation. Why should land held by the peasants now be worked by non-peasants in these localities? It

cannot be assumed that all the campesinos who rent out their plots to other farmers do so because they themselves are incompetent to farm or are too lazy. Do the reasons for the ejidatario's risking renting out lie in his preference for a fixed, steady income and his desire to avoid financial difficulties and fluctuating income levels from farming? Is renting out of land a last resort adopted by an ejidatario who has become deeply indebted to creditors and can see no other safe way of paying off his debts? Furthermore, when the ejidatario incurs a debt in a modern agricultural area, is it, on average, the result of his poor yields and consequently low returns or is the problem more complex?

In undertaking this study it is hypothesized that certain aspects of the Reform hinder the ejidal sector in its task of maintaining viable farming activities especially in a modern development region, here the Northwest. The focus therefore, is on the identification of, and the reasons for the existence of certain operational aspects of the Reform Laws that can be shown to hinder the ejidatarios' farming activities.

Initially, a study is made of all the cropping activities of the main tenure groups to ascertain what broad farm performance differences exist. This line of investigation is undertaken:- To establish whether or not the ejidatarios work their land more or less intensively than the private farmers; whether the ejidal crop yields and prices are markedly higher or lower than those of the private group; and whether the result of any such differences is a considerable disparity in gross incomes per hectare between ejidatarios and particulares. Concurrent with this investigation, data are amassed to measure the variations in farm performance between and within groups and at the same time to make possible the identification of the most productive farming groups within a selected area of examination.

After this initial stage the validity of the hypothesis is tested by sampling the area's most productive farms in relation to size, incidence of double cropping, yields and prices of crops.

In addition, information regarding the use of labour, machinery, fertilizers, pesticides, water and seeds is amassed to assess the cost of operation in order that net incomes can be calculated. It is expected that the ejidal sector achieves poorer net returns per hectare than the private group. On confirmation of that point, further examination of the makeup and cost of ejidal operations is carried out. Furthermore, the critical business of obtaining agricultural credit for the sample farmers is studied, particularly the conditions under which credit is awarded and received, and the costs to the recipient of such financial aid. The use of labour on the ejidal farms is assessed, using techniques based on Rockefeller's study of the Yaqui area (1959/60), while calculations of costs to give the final net income of the farmer are straightforward computations of the data gathered from the individual farms, the water board's records and the relevant credit agencies.\*

The approach of this study, therefore, was to draw on some of the analytical methods used in the economic work done by the Rockefeller Foundation. These, along with standard statistical interpretative methods were the king pins in the measurement of farm activities, incomes and operating costs. In the isolation of possible restraining forces affecting the ejidal farm sample's net income, field interviewing was conducted, in addition to research into farm records in the relevant agencies located in the study area.

In the selection of this area, certain factors have to be considered. From the recent literature, especially the writings of Erasmus (1961), Dozier (1963), and Henderson (1965), and from data presented in the fourth agricultural census of Mexico (1965), it is clear that the Northwestern States of Sonora and Sinaloa have exhibited dramatic agricultural development and modernization in the last twenty years. Nowhere else in the Mexican nation have such extensive land areas been put to use under modern agro-technology, nor is there any other region where the farming population has generated, over a short period, such massive crop production increases

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\*See Appendices 2 & 3 for outlines of the statistical tests applied to the data collected, presented here in Chapter IV.

measured in terms of both weight and value. Hicks (1967) and Dovring (1969) have pointed out that the Northwest is the most dynamic agricultural area of Mexico, producing more of the nation's output and export of cotton, wheat, soya, tomatoes and other vegetables and fruit crops than any other single agricultural region.

Behind the indicated agricultural growth and new economic importance of the Northwest is the establishment by the Mexican Government of several large irrigation Districts in what is essentially the Sonoran Desert. Within these Districts all tenure groups (farming types) are represented and until very recently indeed, agriculture has been the sole source of employment for the rapidly expanding population of the irrigated areas. Agricultural study areas are thus very easily defined on the physical landscape. A line can simply be drawn between economically-active areas and idle, xerophytic scrub-covered desert lands.

The Northern Sinaloan irrigation scheme on the River Fuerte, therefore, is chosen for examination of the ejidal farmer under the influences of the Reform, because of that area's agricultural modernity and very large campesino population. Moreover, the Fuerte scheme presented the same physical characteristics as the schemes in Sonora, being principally gravity-fed by water; it had a coastal plain location on the Gulf of Baja California and was linked to the U.S.A. and the rest of the Mexican nation by a main highway and railroad which together acted as linkages for outside goods and the export of the scheme's valued produce; it had within it, and on its periphery, quickly growing urban centres of population; and its resident farm population was entirely taken up with crop cultivation for national and export markets. This massive scheme appeared further attractive for study (1970) since it was inexplicably ignored in any of the detailed regional development studies or in any of the socio-economic/land tenure studies.

It was decided that the cultivation of wheat would be selected for the measurement of the sample's cereal cultivation and the ultimate identification of the restraining effects of the Reform

Laws. The justification for singling out wheat is that that crop, more than any other in the Northwest, has been adapted and hybridized for cultivation in the region's environment. Cooperative research by the Mexican Ministry of Agriculture and the Rockefeller Foundation has a long history of scientific seed-breeding and the use of the proven hybrid seed is virtually synonymous with wheat agriculture in the irrigation Districts. In other words, relatively high yields are assured to the sample farmers in the areas growing this grain crop.

In summary, the study could be termed a regional-economic examination of a type of peasant farmer in the modern agricultural area of Northwest Mexico. The aim is to establish whether the viability of the ejidal farmer is actually being threatened by his tenure status under the Agrarian Reform Laws.

#### Land Reform - Definitions and Process

Since this paper deals with land reform in an agrarian society, it is necessary to define the specialized terms used. Land reform can be thought of as the process of institutional change required to bring about a redistribution in the pattern of land ownership or tenure rights. The contractual or customary arrangements under which individuals hold rights to or ownership over land are termed the tenure rights<sup>1</sup>. Where land reform is put into effect the process of ownership redistribution must involve changes or modifications to the existing tenure laws of the country. The land tenure laws condition the legal arrangements whereby people in farming gain access to production opportunities on the land (Dorner 1969, 3). Over and above changes in the land ownership pattern, land reform subsumes the idea of creating forces for redistributing income from farm operations on a more equitable basis than before.

In the Mexican case, land reform came in the Revolutionary Constitution of 1917 which laid the basis for expropriating the massive hacienda holdings and hence altering the status quo of the landed class. The expropriated lands of the aristocracy who had



held over 80 per cent of the country's population in a state of peon servitude, were given free to the landless rural proletariat over the following five decades. The rate of redistribution was erratic and was related directly to the electioneering of the several presidents of the Republic who followed Madero (see Table 1).

Under Article 27 of the Constitution the peasant class, campesinos, gradually received free land, with a maximum of 10 hectares being invariably the rule. The peasants became known as ejidatarios, the members of an ejido village, into which they settled and out of which they worked. Either the ejidatario worked his village plot individually or he worked the village land communally. In the latter system, the generated income of the village was divided amongst its members, whilst in the former system the individual received exactly what he himself could earn. Most importantly, and irrespective of ejidal organization, the ultimate owner of the ejidal land was the nation. The ejidatario thus does not possess the right to sell, rent or mortgage "his land", but merely has the right to work it and to its income.

The rationale behind such a situation is straightforward. Prior to the Revolution, inequalities existed in the distribution of ownership of land; by the time of political revolution, it has been estimated that between 82.4 per cent and 96.9 per cent of the heads of rural families were without agricultural property. (Wilkie 1970, 42). The aim of part of the Revolutionary Code was to set this politico-economic problem to rights. Land was given to the rural proletariat on condition that they worked it, leaving no period in excess of two consecutive years with the land idle. Land could be handed down to one and only one member of a family, and the area thus could not be subdivided. This prevented creation of minifundia, subdivided small-holdings. On the other hand, since ejidal land could not be sold, reconcentration of land ownership could not occur, as it had prior to the Revolution. The conditions under which land was given served to provide the peasant with independence, unshackled from the subservience of the hacienda system, and at the same time gave him resources to support himself and dependants.

Table I Recipients of Land by Presidential Term, 1915-1964,  
Area Redistributed, 1916-1967, & Related Presidential  
Policies

Year Term Ends	President	Recipients No.	Av. Ha.	Cumulative No. of Recipients (A)	(B)	Land Area Distributed (1,000 has)	Presidential Policy Orientation
1920	Carranza	446,398	3.6	46,398	1.3		Legal Reform groundwork
1920	De La Huerta	6,330	5.3	52,728	1.5		Provisional 6 months
1924	Obregón	128,468	8.6	181,196	5.1		Began Reform
1928	Calles	297,428	10.6	478,624	13.3	10,618.2	Strongly pro- labour
1930	Portes Gil	171,577	10.0	650,201	17.9		Pro Reform 14 months
1932	Ortiz Rubio	64,573	14.6	714,774	19.5		Tried to halt Reform
1934	Rodríguez	68,556	11.5	783,330	21.1		Resumed Reform
1940	Cárdenas	811,157	22.1	1,594,487	41.6	20,073.0	Strongly Pro Reform
1946	Avila Camacho	157,536	37.7	1,752,023	39.6	5,327.9	Moderation of views
1952	Alemán	97,391	49.7	1,849,414	36.4	4,520.3	Weakened Reform
1958	Ruis Cortines	231,888	21.1	2,081,302	35.5	2,282.0	Less ante Reform
1964	López Mateos	304,498	37.3	2,385,800	35.0	12,500.0	Revived Reform
1970	Díaz Ordaz	---	-	---	-	9,470.0*	Continued Reform

\*1963-67 (B)=(A) as a percentage of the total agriculturally employed.

Sources:- Columns 1-4, Wilkie 1970, 194; Column 5, Venezian & Gamble  
1969, 119; Column 6, Needler 1971, 2.

Furthermore, and ideally, the nation's agricultural output would be augmented by the peasants' labours, since it had been asserted that the haciendas were frequently not maximizing their outputs, given their vast resources.

Directly related to the Mexican tenure system are the agrarian credit institutions. Just as the private property group is legally quite a different entity from the ejidos and vice versa, the private group has its own credit institutions. The particulares' credit sources grew up spontaneously in response to that group's possession of mortgageable property. The ejidal credit agency was eventually created by the Federal Government for the assistance of these farmers who did not hold securities against credit advances. Such government intervention in the field of agrarian credit would not have been as necessary, *ceteris paribus*, had it not been for the peculiarities of the ejidal tenure status.

In summary, the landless rural proletariat was given land by the Revolution, but the recipients did not possess their land in a legal sense. The haciendas were dissolved and with their collapse severe limitations were placed on the size of private holdings.\* The landed sector of the farm population was nonetheless the latter group, since they "owned" their land and in favourable circumstances could legally purchase more land. An ejidatario could not legally purchase additional ejidal land. *Laissez-faire* operated to the private owners' advantage by establishing credit banking for agrarian users. The ejidal sector was not served credit-wise on any significant national scale until the government stepped in with the Ejidal Bank in 1939 (Wilkie 1970, 141). Not surprisingly, the delay in assuring financial aid to the ejidal farmers has frequently been cited as part-cause of the poor ejidal level of output, which, till the period 1950-60, exhibited considerably slower growth rates than those of the private sector (Dovring 1966 & 1969).

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\*See Appendix 1 for details of land unit sizes under Article 27 (1917).

CHAPTER 11

## THE FUERTE IRRIGATION DISTRICT: THE REGIONAL CONTEXT

Large Scale Agro-Irrigation Development in Northwest Mexico

The large irrigation schemes of Sonora and Sinaloa are Mexico's equivalents of the Californian Central Valley or of Arizona's Imperial and Salt River schemes. (See Table 11). These two northern states of Mexico contain its agricultural showpieces, yet some thirty years ago there was no commercial agriculture. Today's boom cities of Guaymas, Ciudad Obregón, Navajoa and Los Mochis were just small villages whilst the old historic centres of Hermosillo, Alamos, El Fuerte, Mocorito and Culiacán were the foci of rudimentary social and economic activity. At that time, the only all-weather route was the railroad through the region, linking with Nogales in the north and Tepic, Guadalajara and Mexico City in the south. There was no paved highway right through from the U.S.A. border, whilst port facilities were almost entirely concentrated in the southern end of the region at Mazatlán. The populations of Sonora and Sinaloa in 1950 were respectively 510,607 and 635,681. Today the equivalent figures are respectively 1,092,458 and 1,273,228\*, representing a growth of 114.0 per cent and 100.2 per cent over two decades. Over the period 1940-1960, the North Pacific region, consisting of Baja California Norte y Sur, Nayarit, Sonora and Sinaloa, was the fastest expanding crop production area of Mexico, quadrupling its output (Reynolds 1970, 110).

The incredible transformation of this peripheral region of Mexico in the space of a few decades is totally bound up with massive governmental investment in flood control, water reservoir construction, electrical power generation and the provision of

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\*Provisional data from the 1970 Population Census, June 1970

Table 11 Irrigation Districts of the Sonoran Desert

(hectares)		
U.S.A.	Gravity	Pumps
Imperial Valley	151,760	15,378
Coachella Valley	31,566	8,903
Blythe-Palo Verde	28,328	2,832
Fort Yuma Indian Reservation (Cal.)	6,070	
Yuma & Gila Projects	50,586	10,926
Colorado River Indian Reservation (Ariz)	12,545	Supplemental
Cibola & Ehrenberg	3,642	
Salt River Valley	73,654	53,419
Safford-Artesia	12,140	404
Duncan	2,023	
Casa Grande	20,234	72,035
San Pedro Valley/Rainbow/Gila River/ Tonapah/McMullen/Centennial Wash		87,009
Sub Total - American Sector	392,553	250,910
Mexico		
Méxicali	153,783	8,093
San Luis, Colorado	29,947	2,023
Río Altar	3,237	2,023
Caborca		46,135
Imuris/Santa Ana/Magdalena/Trincheras	2,832	2,913
Costa de Hermosillo		95,507
Hermosillo (Rodríguez Dam)	12,950	Supplemental
Valle de Guaymas	809	12,950
Río Yaqui	230,675	Supplemental
Río Mayo	83,771	Supplemental
Río Fuerte	242,816	Supplemental
Río Sinaloa/Mocorito	93,079	Supplemental
Río Culiacán	110,076	Supplemental
E. Sonoran(Sierra Valley bottoms)	14,528	7,770
Sub Total - Mexican Sector	978,510	177,418

Source:- Adapted from Dunbier 1970, 213-214.

infrastructure such as paved highways and piped drinking water. The cost of the investments has been very large and beyond the immediate resources of Mexico. The main sources of the much needed capital have been and still are the International Bank for Reconstruction and Development (IBRD), the Agency for Development (AID), the Inter-American Development Bank and the World Bank. The investment in this region, associated with the agrarian reform programme, more than anything else has brought about the rapid growth of crop production after 1940. Some indications of the investment by the government in the north and northwest are given in Tables III-V, clearly revealing how these two regions received the largest benefits from 1940 to 1960. During that period the north and north Pacific areas received almost 80 per cent of the Federally irrigated land, over 50 per cent of newly paved highways, and accounted for 67 per cent of net private investment in agriculture (Reynolds 1970, 157 & 159).

The specific irrigation schemes - eight in number - responsible for the north Pacific's recent rise to the fore in national agricultural output are shown on Map 1.

With the exception of the Costa de Hermosillo and the Río Colorado District, these schemes rely for their water supplies on the artificial lakes that are created on the edge of the Sierra's west and southwest valley mouths, out of which flow the seasonally flooding rivers. The relatively heavy soils of the scheme areas are the product of years of alluvial outwash accumulations deposited in noticeable layers marking the frequency of periodic floods. Over the years varying from 25 to 5 years for which there are climatic records, all stations have registered moisture deficiencies. Annual precipitation ranges from 59 mm on the Colorado District to 910.2 mm on the Culiacán scheme. The temperature ranges from north to south, with a January minimum of around 12°C at the Colorado District to 18.4°C at Culiacán, and a July maximum of 33.2°C at Colorado to 33.3°C on the Yaqui District. The frequency of frost is uncommon south of the Mayo

MAP 1

THE MAIN IRRIGATION SCHEMES  
OF N.W. MEXICO

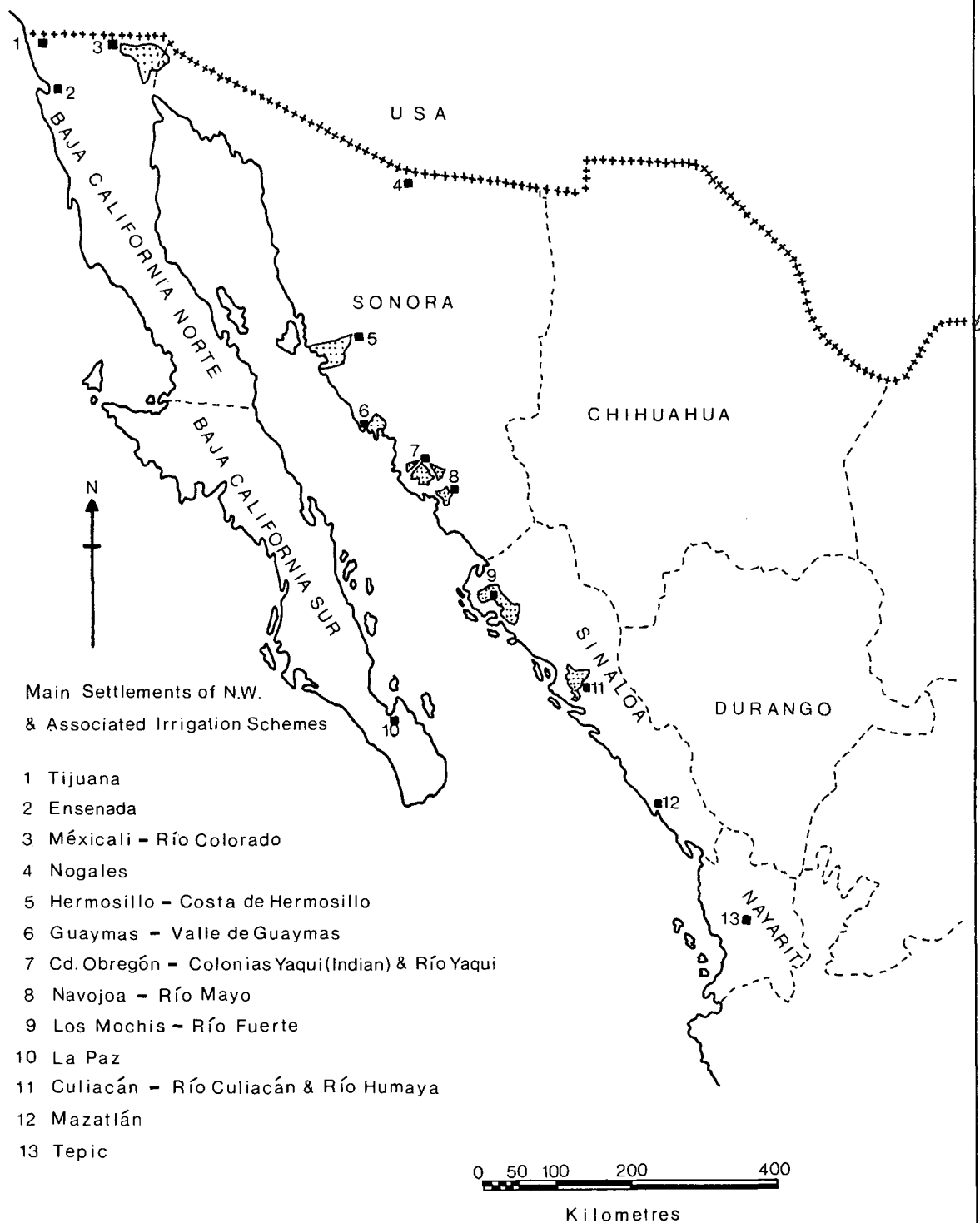


Table III Land Area Benefited by Major Federal Irrigation Projects, 1930-58

	('000 hectares)			
	1930	1940	1950	1958
North	2	97	363	560
Gulf	0	0	5	53
North Pacific	0	37	402	839
South Pacific	0	0	21	24
Centre	15	123	247	400
Mexico	17	257	1,038	1,876

Table IV Land Benefited by Major Federal Irrigation Projects as Percentage of Total Area Cultivated, 1939-59

	(%)		
	1940	1950	1959
North	4	12	15
Gulf	0	0.3	3
North Pacific	4	39	53
South Pacific	0	1.4	1.2
Centre	3	6	9
Mexico	3	9	14

Table V Regional Construction of Paved Roads, 1935-55

	% of Total Land Area	% of Cultivated Land	Building of Paved Roads 1935-40		Building of Paved Roads 1940-55	
			Km.	%	Km.	%
North	41	27	1,429	39	3,897	30
Gulf	12	11	247	7	1,489	11
North Pacific	21	9	125	3	2,578	20
South Pacific	12	14	455	12	1,457	11
Centre	14	39	1,438	39	3,543	27
Mexico	100	100	3,694	100	12,964	100

Source:- Tables III, VI, V respectively from Reynolds 1970, 156, 156, & 157.



scheme, but damage to crops by this hazard has occurred every 5-6 years north of that area, particularly so on sections near Méxicali.

Land redistribution did not start to affect the Northwest until the extremely active reform period under the Cárdenas regime in the late 1930s. The main pressure for reform came from the small rural population which had had strong ties with prominent leaders of the Revolution. The campesinos had much justification for discontent in the decade of the 1930s since the extremely large livestock haciendas had not been touched by the expropriation process, and hence redistribution had not gone forward to any significant extent.

With the breakup of the landed estates between 1938-42, the ejidal class made its entry into the Northwest's farmer sector. At the same time, initial feasibility studies were begun by the Comisión Nacional de Irrigación later known as the Secretariat de Recursos Hidráulicos (SRH), to determine whether large scale extension of the then very limited agriculturally worked areas was possible. With the exception of the large American sugar cane interests in the Los Mochis area on the Fuerte delta, there was no important commercial crop output area; since almost all the deltaic zones operated their meagre agricultural activities without large water storage facilities. Agriculture was conducted by sowing one crop per year and its subsequent germination depended on inundation during the flood periods in March and April. Extreme rainfall variability meant that the rewards from crop cultivation and livestock operations were very erratic.

In short, the Northwest's environment presented too many hazards for extensive development in agriculture of any variety for the small population without vast hydraulic and infrastructural investment. Hence the region did not then support the high densities of rural population found elsewhere in the more humid southern and central upland states of the nation. What population there was was concentrated in a few odd settlements and along

sections of the main Sierran rivers that spilled into the Gulf of Baja California. Forestry and mineral exploitation were not operated on a scale to warrant in-migration of any significance. Owing to meagre demand, local use of these resources was minimal, and their inaccessibility from the country's principal markets hindered their national use.

Between 1945 and 1960, however, SRH built major dams on the Sonora, Yaqui, Mayo, Fuerte, Sinaloa and the Culiacán rivers which by 1964 were all operating fully and supplied water for agricultural purposes, electrical generation, drinking and settlement services to a production area exceeding 800,000 hectares (2 million acres). Paved highways linking rapidly expanding ejidal settlements were built, and the Nogales and Tijuana west coast highway to Guadalajara and Mexico City was completed. The railroad connection with the U.S.A. had had its tracks almost completely rebuilt and relaid since the work began in the mid 1950s, whilst modern diesel-powered locomotives were now regularly operating. The only trans-sierran crossing was completed in the early 1960s with the Chihuahua - Los Mochis - Topolobampo railroad. This link made possible the shipment of produce to the Texan and eastern U.S.A. fresh vegetable markets from which this Mexican region has received considerable export revenue. Concomitant with this railroad's completion, wharf facilities were up-graded at Topolobampo with drive-off ferry facilities to La Paz on the southern tip of the Baja. Investment was also made in the expansion of fish packing facilities for the shrimping industry. Similar port developments were undertaken further north at Guaymas, where oil storage plants were also built. Permanent airstrips were built at Culiacán, Los Mochis, Navajoa, Ciudad Obregón, and Hermosillo, at the beginning of the 1960s, making possible very rapid inter-connection of these main towns. To a considerable extent, the presence of SRH and its need for air facilities to inspect its Districts acted as a stimulus to the development of air transportation.

The main crop outputs of the Northwest's irrigation schemes are

cotton, wheat, rice, sugar cane, sorghum, tomatoes and the ubiquitous corn and beans. All are primarily for national markets and, depending on home demand and world prices, they are, except for corn and beans, also frequently for export. No single production region is a principal producer of a wide variety of crops, but each, due to some climatic or locational factor, is a main producer among the intra-desert regions, of at least one of the major commodities. Although any field may produce two crops annually, wheat and cotton, the most widely planted crops, have growing seasons which are mutually exclusive. The farmers must choose one or the other, because, once the area has begun to specialize, the investments needed to plant, cultivate, harvest and process the crop are so large that the region is compelled to continue the production of the most remunerative single crop.

This is borne out by the case of cotton, which since the mid 1950s has displaced wheat as the most important commodity grown in the Sonoran Desert. The success of cotton rests in large measure on the coincidental outbreak of the Korean War at the time when thousands of hectares were coming under irrigation for the first time. The world price for the fibre spiralled upwards to such an extent that farms from Méxicali and Hermosillo to Fuerte and Culiacán planted the crop, and invested in its cultivation irrespective of the suitability of their lands and the hazards of high local humidities at picking time. As Dunbier (1970, 246) states: "The profits from this single crop during a few short years gave more impetus to the development of agriculture in the Mexican Northwest than any other economic factor aside from irrigation itself." By the mid 1950s the Sonoran Desert became Mexico's main cotton producing area, the output of the State of Sonora alone accounting for over 50 per cent by weight. Owing to the rapid expansion in this area Mexico became the World's fifth largest producer after the U.S.A., U.S.S.R., China, and India. The profits then were

much higher than today. This was because the use of fertilizer was very low, due to the fact that virgin land was being cultivated which had sufficient nutrients for initially high yields. The higher yields obtained today are the result of intensive applications of insect and weed controls plus nitrogenous fertilizers. The need for disease control has risen as the regular hectares sown in cotton have expanded; concomitant with this, the costs of production have risen (Dunbier 1970, 246).

A breakdown of the characteristics of the irrigation schemes' production is given in Table VI. It should be noticed that the more humid areas south of the Mayo District, where frost is rare and water supply more adequate, exhibit greater diversity in their choice of cultivation. There is specialization of course, but these schemes have the ability to respond to market price and demand more readily than the northern Districts through their ability to maintain more varied crop activities.

Not only are there variations in the crop production patterns from scheme to scheme, there are also considerable variations in the tenure makeup of the Districts and the average size of farms (see Table VII). Clearly the Costa de Hermosillo area exhibits exceptional concentration of land in private hands. This area was opened up by the government almost exclusively for private interests. Since this event coincided with the boom demand for cotton, the land that had been previously cultivated under wheat was rapidly extended, with private investment in many new deep wells, and the area's speciality thus became cotton. In all the major Districts, with the exception of the Fuerte District, the ejidal sector holds less than 50 per cent of the area, and yet that sector, excluding the Hermosillo area, represents over 50 per cent of the Districts' farmer population.

It should be observed that the information given about farm size is the official view and makes no provision for calculating the actual worked size of farms or for the actual active farm population where renting out of ejidal land to other operators

Table VI Crop Production Characteristics of the Northwest  
Irrigation Schemes, Mexico, 1967/68

	Méicali	Hermosillo	Yaqui	Mayo	Fuerte	Culiacán
Total Value of Output ( '000s pesos)	895,432	550,321	1,087,695	4407,151	820,094	822,160
Total Area Harvested (has)	171,181	107,204	206,366	108,048	181,373	96,837
No. of Main Crops cultivated per annum exceeding 1 million pesos in value	9	9	15	15	18	16
10 Principal Crops by descending order of value	1 C. 637,289	C. 328,073	C. 494,446	C. 129,721	C. 296,090	Tm. 491,418
	2 Wh. 153,079	Wh. 200,298	Sy. 237,260	Wh. 76,356	Tm. 148,649	Sc. 104,879
	3 Al. 46,785	Cf. 6,510	Wh. 227,447	Sy. 46,361	Sc. 112,876	R. 78,455
	4 S. 21,277	Gr. 5,670	Mz. 55,794	Sg. 38,528	Wh. 54,051	Cc. 41,870
	5 A. 9,816	B. 2,330	Sg. 20,105	Ss. 23,010	Sy. 44,718	Sg. 40,822
	6 Br. 9,537	Sg. 2,329	Ss. 18,356	S. 20,924	Sg. 41,246	B. 14,405
	7 Vr. 7,885	Al. 2,232	Al. 7,711	Ch. 17,933	R. 27,242	V. 13,460
	8 Sg. 5,044	Cp. 1,650	S. 6,063	Mz. 13,029	B. 21,834	Cl. 9,537
	9 G. 4,371	S. 1,227	Ml. 4,212	V. 10,189	P. 15,836	Fr. 5,586
	10 Fo. 346	--	F. 2,464	Cl. 8,900	V. 13,804	Wh. 4,596

\* Symbols:- A=Asparagus. Al=Alfalfa. B=Beans. C=Cotton. Cc=Cucumber. Cl=Chile. Ch=Chicare. Cp=Chickpeas.  
Fr=Fruit. G=Garlic. Ml=Melon. Mz=Maize. R=Rice. P=Potatoes. Sc=Sugar Cane. Sg=Sorghum. Sy=Soya.  
Tm=Tomatoes (export). Ss=Sesame. S=Safflower. Br=Barley. Cf=Citric Fruit. Gr=Grapes. Wh=Wheat. V=Various.

Source:- Compiled from Dirección General de Distritos de Riego. Características de los Distritos de Riego. Vol.1. Mexico City: Secretariat de Recursos Hidráulicos, 1969.

Table VII Allocation of Land Held by Main Tenure Types, Number of Farmers and Average Farm Size for the Principal Sonoran Desert Irrigation Areas of Mexico, 1967/68

	Méxicali	Hermosillo	Yaqui	FMáyoe	FFuértean	Culiacán
<u>Area held</u> (has)	229,927	143,915	205,178	95,924	201,844	95,665
Total						
Ejidal	109,584	1,200	73,285	45,845	118,989	32,278
Private	120,343	142,715	131,893	50,079	82,855	63,387
<u>Farmers</u>						
Total	11,881	1,533	7,655	11,906	15,281	6,820
No. of Ejidatarios	6,636	81	4,238	7,740	13,081	4,813
No. of private owners & colonos	5,254	1,452	3,417	4,166	2,200	2,007
<u>Average size of holding</u> (has)						
Total	19.44	93.9	26.8	8.1	13.2	14.0
Ejidal	16.5	14.8	17.3	5.9	9.1	6.7
Private, with colonos	22.9	98.3	38.6	12.0	37.7	31.6

Source:- Secretaría de Recursos Hidráulicos, Dirección General de Distritos de Riego. Características de los Distritos de Riego, Vol.1. Mexico City: Author, 1969.

takes place. Moreover, the average sizes of the properties under private ownership are not completely representative of the true situation, since ownership of over 100-150 hectares is concealed from the authorities in token respect for and adherence to the Reform Laws. Unfortunately systematic data that might remedy the above situation are not available from any source, even for a single scheme area. The farm sizes shown are merely the result of dividing the respective tenure groups' total holding areas by the number of assumed active farmers in a particular group; active farmers are equated with those individuals officially registered as holding farmland. Hence, land that is as yet uncleared and unlevelled is included within these figures, as is land that is contaminated by salt from years of over-irrigation.

#### The Development of Irrigation and Agriculture on the Fuerte

The Río Fuerte irrigation scheme, or the Valle Del Fuerte, District No.75 as it is referred to in the SRH files, is situated just south of the Sinaloa-Sonora border on the lower eastern shores of the Gulf of California. The history of irrigation in this large coastal plain below the Sierra, dates back to the late 1880s, when records show that approximately 1,300 hectares were cultivated on the lower delta zone, mainly for corn, beans (frijol) and sugar cane. The technique of irrigation was crude and simple, using merely earth ditches and embankments to divert and retain the Fuerte's flood waters that regularly spilled over the delta area. Permanent canals and drains were not in evidence.

By 1892, however, a 12 kilometre long canal was in existence, the Canal Taxtes, and by 1905 the cultivated area had grown to 8,000 hectares. This growth was associated with the arrival of the American Albert Owen (see Robertson 1964) and the establishment of his colonists' settlement on the Bay of Topolobampo. As early as the beginning of this century, Owen recognized something of the valley's potential for large scale agricultural development,

with his proposal for a main rail linkage over the Sierra to Chihuahua and to the markets of Texas and the American Midwest. Owen's dream is now realized, (1970) some seventy years later, but the nature of the landholdings, their management and organization, their variety of output, and the markets for that output are considerably removed from those he envisaged.

The most significant engineering developments took place immediately after the Second World War and are now outlined chronologically.

The construction of the main canal system in the late 1940s was financed by the Federal Government after considerable pressure was brought to bear by the local ejidal (collective) society. For example, the Canal Sicae, inaugurated in Sept. 1947, was built at a cost of 18 million pesos by the Government and measured some 72 kilometres. This work can be regarded as the first major irrigation structure in the valley's history of development. An indication of this canal's importance can be gauged from the subsequent expansion of the cultivated land area. In the agricultural cycle of 1947/48, the area cultivated was 35,000 hectares. By 1951/52 this had increased to 52,000 hectares.

The birth of District No.75, Valle Del Fuerte, came in a Presidential decree of June 27th, 1951, which announced the setting up of the Comisión Del Río Fuerte (CRF). The Comisión was assigned the task of planning and carrying out the expansion of the cultivable land in the Fuerte Valley, particularly those areas that could be served by an integrated system of canal irrigation using the controlled flow of the Fuerte's water catchment, distributing the water by gravity along two or three main canal routes, and enabling electricity to be generated.

The Comisión for the Fuerte, like that for the ill-fated Papaloapan Basin (see Poleman 1964), is organized within the SRH but is at the same time a completely independent planning development unit. Certain zones of Mexico were selected by the Federal



Government for "complete regional development", development that would be carried out by an autonomous Federal Agency, based within the development zone, and in immediate and permanent contact with the tasks in hand. A Mexico City base for such large scale investment was thought to be less advantageous, hence the Comisión's inauguration and establishment at Los Mochis, Sinaloa in 1951.

Between 1951 and 1956 were constructed the now-existing water distribution networks, the dam and power sites at Miguel Hidalgo above the old regional capital of El Fuerte, the main left and right bank canals, to serve areas north and south of the old river course, the main drains to the Bay of Topolobampo, and the principal rural roadways alongside the canals and laterals. The year 1956/57 marked the first complete agricultural cycle under controlled irrigation, when an area of 124,412 hectares was sown in a variety of crops. In the cycle of 1955/56 the area sown was 60,307 hectares, yielding a harvest value of 113.29 million pesos, compared with 236.07 million for the following year. By 1969/70 the area sown had reached 200,938 hectares with a production value of 1,029.59 million pesos, when 85.77 per cent of the irrigable land was in operation (see Table VIII).

The organization and management of the District's sub-areas were modified in 1964/65 to produce larger, but fewer and more efficiently shaped units. The system set up in 1956 had divided the area served by the Miguel Hidalgo water supply into eight separate Units. The alteration in 1964/65 reduced this number to five, giving easier organization of water distribution, canal controls and drainage. This year also marked the beginning of greater statistical coverage by the Comisión of the varied activities involved within its development area. Administratively the Valle is broken down into Units, Zones and Sections in descending order of size.

The year 1964/65 can be thought of as the turning point in the District's developmental process, when the area emerged from its initial phase of construction and water distribution, and

Table VIII Analysis of the Agricultural Expansion of the Fuerte District, Sinaloa, 1944/45-1969/70

Agricultural Cycle	Area Sown (has.)	Production (tons)	Value (pesos)	% of Area Sown*
1944/45	28,723	414,238	31,968,666	--
1945/46	31,558	385,612	35,592,588	--
1946/47	30,914	457,713	40,550,390	--
1947/48	35,355	533,892	52,458,091	--
1948/49	41,906	569,253	67,030,344	--
1949/50	47,048	567,505	74,116,094	--
1950/51	46,003	533,559	80,068,974	--
1951/52	51,729	496,155	88,148,228	--
1952/53	47,727	537,105	85,933,556	--
1953/54	54,615	511,090	99,546,964	--
1954/55	71,685	414,260	139,219,340	--
1955/56	60,307	402,151	113,287,860	--
1956/57	124,412	536,295	236,074,333	57.02
1957/58	149,842	827,564	301,111,764	68.68
1958/59	110,698	957,993	259,532,945	50.73
1959/60	156,290	1,061,888	373,396,315	71.63
1960/61	163,900	1,133,757	414,053,543	75.12
1961/62	157,038	1,076,404	368,447,912	72.93
1962/63	151,242	1,115,452	425,564,000	69.32
1963/64	162,896	1,452,642	585,248,473	74.66
1964/65	174,314	1,544,813	649,229,390	79.89
1965/66	178,408	1,630,432	951,124,830	79.53
1966/67	200,789	2,429,262	985,422,104	89.50
1967/68	201,627	1,954,867	812,786,058	87.88
1968/69	220,721	2,285,127	930,405,033	98.39
1969/70	200,938	2,130,734	1,029,587,724	85.77

\* This column represents the area sown as a percentage of the total area susceptible to irrigation. 1956/57-64/65 susceptible area was 218,190 has. 1965/66-69/70 the area had risen to 224,339 has.

Source:- Compiled from data supplied by CRF, Los Mochis, June 1970.

advanced into a phase of intensification of production, with increased efficiency in all aspects of water-handling.

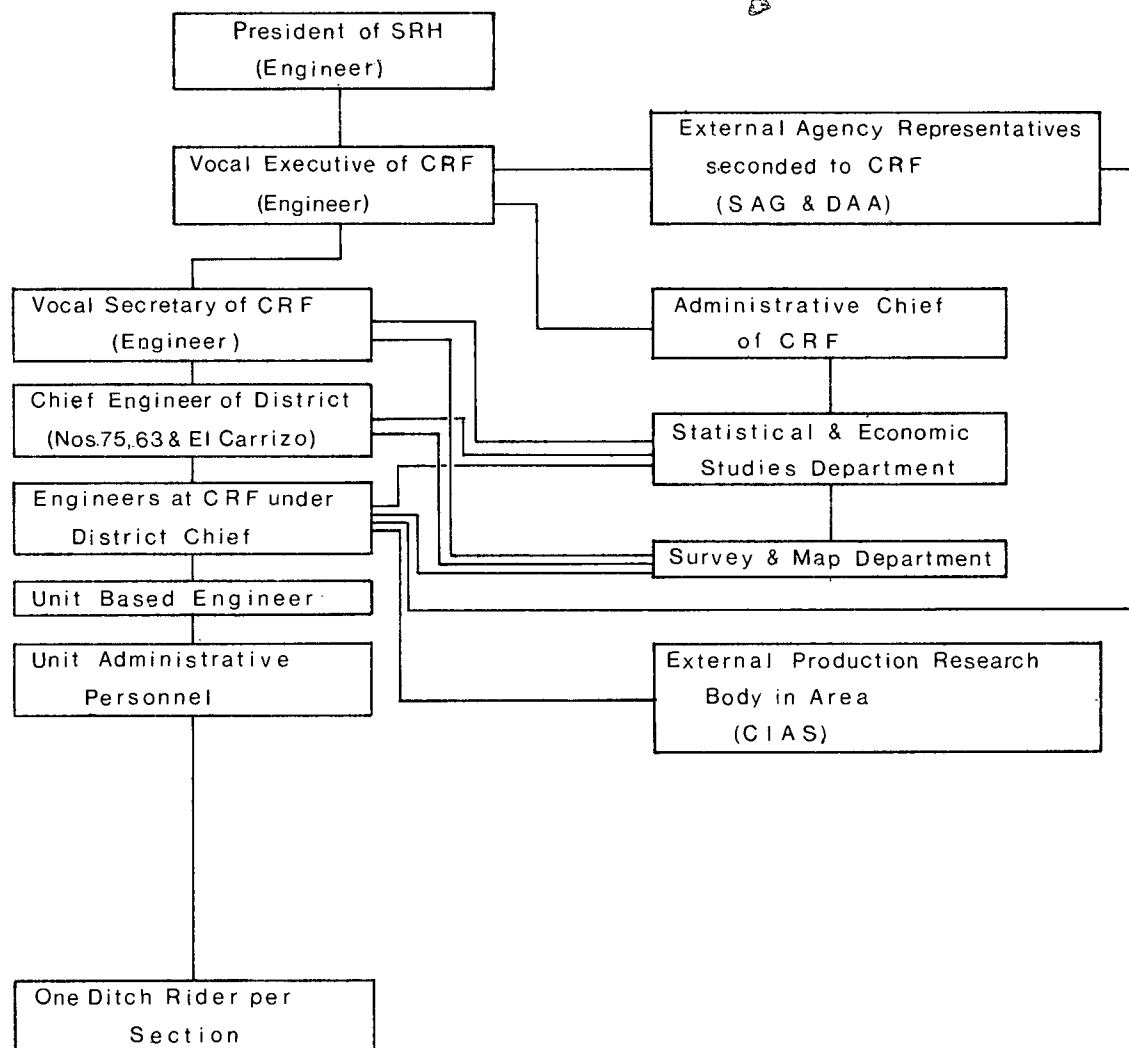
#### The CRF: Organization and Aims

As stated previously, the CRF is a semi-autonomous body, within the administrative structure of the Federal Agency of the Ministry of Water Resources (SRH) in Mexico City, and based in Los Mochis, Sinaloa. Although investments in the construction of the Miguel Hidalgo dam, whose initial cost and recent heightening amounted to 361.15 million pesos, the more recent Josefa Ortiz de Domínguez dam costing 227.9 million pesos, the canal systems, the engineering of ditches and the Rehabilitation scheme costing 230 million pesos have all had their source in SRH, it is CRF that makes the requests for such finance. It might be argued that as a result of this dependence on financial decisions outside CRF's own control, CRF might suffer. As it happens, quite the opposite seems to be the case. This can be attributed, at least in part, to the expertise and respect that the Comisión's engineers have earned since the initial construction phase of the 1950s when financing was a simpler business. Today, for example, when CRF requests funds for the concrete lining of a part of a main canal, SRH accedes to the request providing that CRF presents them with a detailed analysis of the probable costs of several methods of construction and the benefits from the investment, such as the saving of water through reduction of seepage and clearing of weed growth.

The organization of CRF and its area can be illustrated in the Figures 1, 2, and 3. In Figure 1, the Vocal Executive (Comisión Director) is shown to be coordinator of all CRF business and operational tasks. All main contact with SRH goes through him although the Vocal Secretary, the Chief Engineer of the District and the Administrative Chief all have simple access to SRH in Mexico City. The President of SRH is given the title of CRF President but this is merely a nominal title and in the Figure (1) this individual is shown only to illustrate the point that all contact

FIGURE 1

INTERNAL STRUCTURE OF CRF AND LINKAGES  
TO SRH AND OTHER AGENCIES

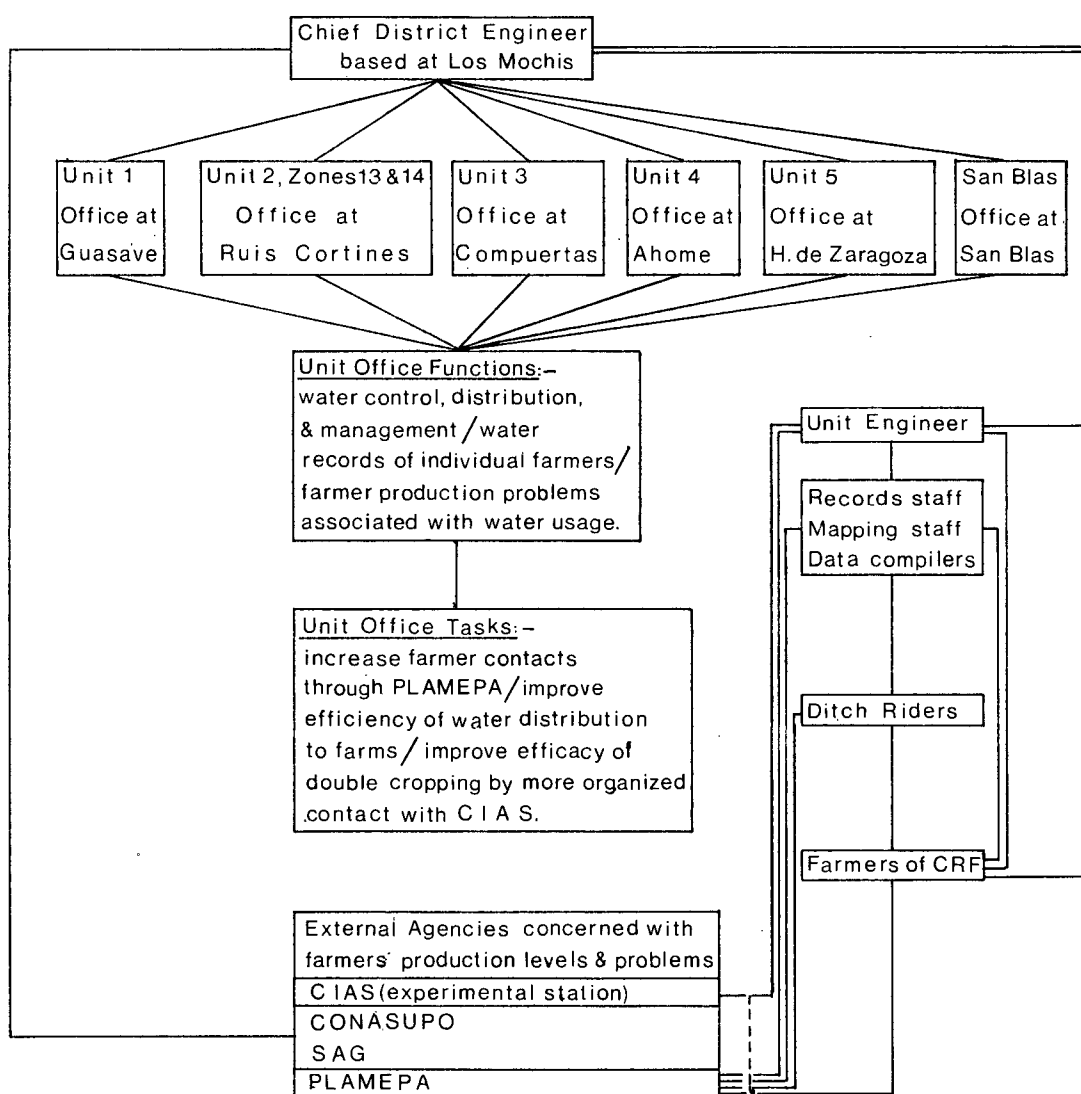


CRF has with SRH is at a senior level of officialdom. Note should be made of the presence of two important outside agencies within CRF itself, namely the Ministry of Agriculture and Livestock (SAG) and the Department of Agrarian Affairs (DAA). The representatives of these two agencies deal with problems, invariably ejidal, of seed use and plant husbandry, and of prospective ejidatarios' petitioning for new lands and the granting of land title documents. Even though the scheme area is physically limited to the area served by the water supply, not all that land is yet cleared or prepared for agricultural use. Given that the area's population is growing at about 5 per cent per annum, the combined effect of the high natural increase of upwards of 3 per cent per annum, and of considerable in-migration, the magnitude of the peasant sector is expanding and demands a share of the irrigable land. Because of the squatting on the private sector's land, sometimes working it where it is idle, or the petitioning for new ownership, there is constant need for DAA representatives in the region. Their presence on location considerably speeds up the transfer of land ownership, since the quantity of red tape is vastly reduced when there is no need to have all the decisions channelled through Mexico City.

To some extent, it could be argued that the DAA based in Los Mochis is liable to bow to pressure brought to bear on it by the private farmers, because of the agency's representatives' constant proximity to them, and that, in the end, the demands of the ejidal sector for more land might be over-ruled in favour of the arguments of the private sector against more redistribution of land resources. This conflict of interests is an in-built feature brought about by the operation of the Reform Laws. The argument supported by many of the DAA agents is that land, which is most productive under private exploitation, should not be split up and donated to the ejidal sector only to fall off in productive capacity under less experienced or skilful hands. This notion is further supported by the fact that CRF needs the District's agriculturalists to keep on increasing their output in order that quick repayment of

FIGURE 2

ORGANIZATION OF THE CRF SUB-AREAS, INDICATING  
MAIN ROUTES OF FARMER - SCHEME EMPLOYEE  
COMMUNICATION



----- Imminent line of communication not yet operating

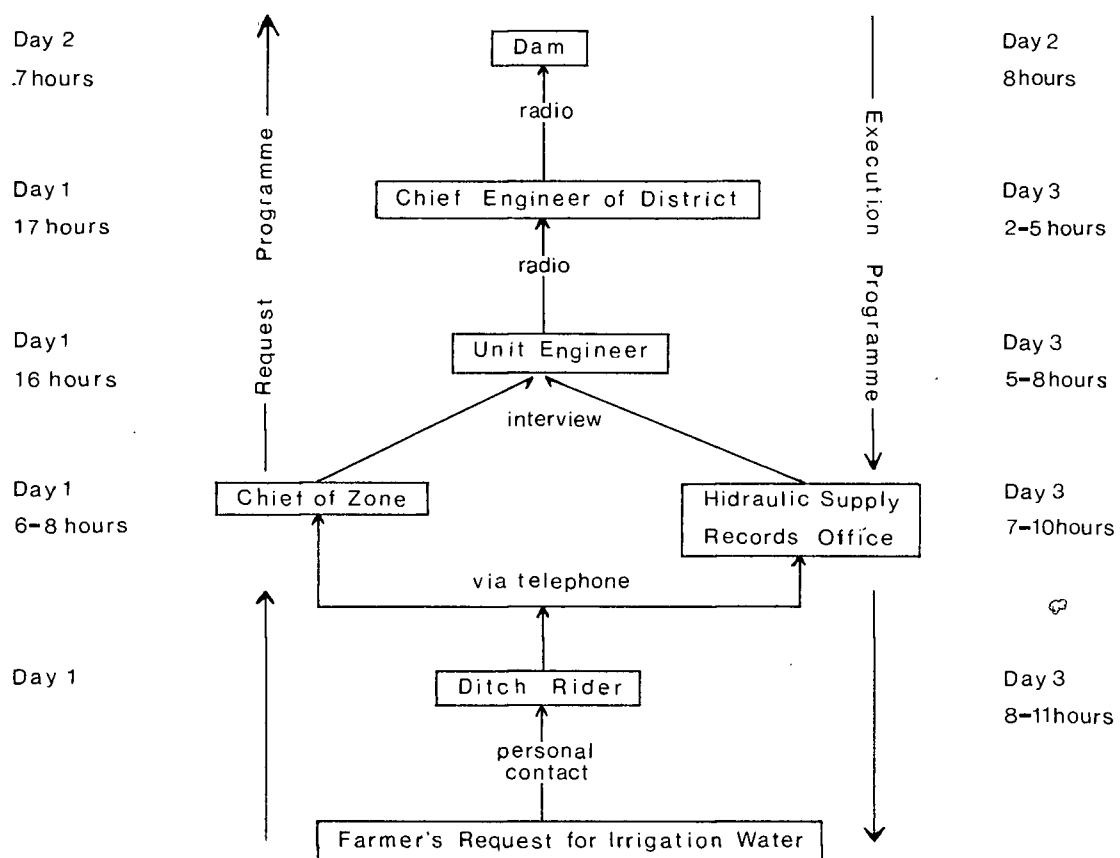
foreign aid be achieved. Quick repayment means minimization of interest costs and also increases the likelihood of further loans being immediately forthcoming at good terms when required.

Figure 2 shows the internal organization of CRF's water management for the sub-area Unit divisions of the whole Fuerte scheme. Although each separate Unit engineer is shown as being responsible to the District Chief, they obviously work in cooperation with other engineers also under the District Chief at Los Mochis. There is provision for instantaneous communication between Los Mochis and any of the Unit offices, either by telephone or by radio, since all of the scheme area is within reach of the Mochis transmitters. Such communication facilities also exist between Mochis and the dam sites at Miguel Hidalgo and Dominguez. (Figure 3).

Farmer contact with CRF is most strongly developed first and foremost at the Unit office and may subsequently develop also at the Comisión's headquarters in Mochis. Water payments are made by the farmers to the Unit offices where they also discuss their water supply problems and aspects of their cultivation cycle. The normal route of communication is shown as from farmer to Unit engineer, but if the farmer is not satisfied with the latter he can easily go to Mochis and see the District Chief. With regard to water management and requests for irrigation water the Ditch Rider (Canalero) is responsible for the operation of the canal lateral gates and water depth maintenance in accordance with the supply programme for the Unit within which he is based. Each Canalero is in charge of one section, a water management subdivision of a whole Unit. These individuals in the CRF scheme do not require much education although they are all literate and competent at the simple arithmetic necessary in their record keeping. The Ditch Rider is given a Comisión-built stone house, usually fairly central to his section, the house being supplied with a small vegetable garden, power, water and telephone. He also has a Japanese motor cycle which he buys with some aid from CRF. The Ditch Rider must be married since there must always be someone near the telephone or in the house when he is out, in order to take

FIGURE 3

CYCLE OF DEMAND FOR WATER  
IN THE CRF SCHEME



The time interval between request and receipt of scheme water of between 80-83 hours is the maximum time lapse needed for a Unit lateral to be filled from dam-released water. The figure makes no provision for water being more quickly available from Unit laterals already primed.



messages from the Unit office and also from farmers who may try to contact him. The wife thus fills an important role in the communications link. In some cases, found in Unit 2, the Ditch Rider was also an ejidatario and/or small private farmer at the same time as being employed by CRF. This made for particularly good communication of farming problems concerning water supply and many other aspects, with high levels in the scheme's management. In the case of Ditch Riders who come to own pickups, Datsuns or Chevrolets, the CRF aids in vehicle purchase by obtaining an 8 per cent price reduction for its employees. The trucks are then fitted with shortwave sets so that the occupants can be in constant touch with the Unit office when not at home.

Another communication link which already operates but which is about to work much more effectively is that between the farmer (primarily the ejidatario) and the Agricultural Research Centre of Sinaloa (CIAS) and the Plan for Improving Plot Efficiency (PLAMEPA). To date, CIAS has made its findings known to the farmer population through farmer demonstration days. Official recognition of the fact that still more contact is needed for the ejidal sector to improve its performance is indicated by the dotted line linking CIAS direct to the farmer in Figure 2. This will be accomplished with the collaboration of the PLAMEPA manpower team in the CRF area, since duplication of extension officials needed for this task would be both wasteful in manpower and impractical, given the existing shortage of the required personnel.

#### The Aims of the Fuerte Comisión

In the space of some 15 years since the inauguration of full scale irrigation under controlled water supplies from the dams, the CRF has brought approximately 200,000 hectares of desert scrub-land on the coastal plain into productive intensive agricultural use. In the last harvest year completed, 1969/70, the value of total District output had exceeded the 1 thousand million pesos mark, no small achievement when compared for instance with 649,229,390 pesos in 1964/65. The Yaqui scheme, although exceeding

that figure prior to 1969/70 started full irrigation some three years earlier than the Fuerte scheme, and had a larger productive private sector. The populations of the municipios (counties) to benefit most from the creation of productive land resources, Ahome and Guasave, grew between 1960 and 1970 by respectively 84.9 per cent and 63.0 per cent\*, considerably exceeding the rate of 50.9 per cent for the whole state of Sinaloa. Furthermore, electricity and drinking water have been brought to the rural population by the CRF with the Federal Commission for Electricity (CFE), not to mention the hospital facilities built in the main rural centres like Las Vacas and Ahome, and of course in the urban nodes of Los Mochis and Guasave.

The current aims of the Comisión are as ambitious as those it has fulfilled since 1951. First, over the twenty year period commencing in 1964, CRF is trying, by encouraging the cultivation of more valuable crops, to increase the value of harvests in the District so as to guarantee prompt repayment of the 230 million pesos loan for rehabilitation of 64,000 hectares of salty land, and for infrastructural development initiated during the López Mateos regime. There is already a programme of quite intensive training of Ditch Riders and other Unit-based employees in aspects of water management at a field-scale level. It is believed that when such individuals have been exposed to intensive learning and discussion with the highly trained and experienced scheme personnel, especially the senior engineers, the Unit staff will be much better equipped to help the ejidatarios in the most effective use of water. It is intended that the above programme be run once a year for every Unit personnel member for several years so that new technical developments can be passed on and refresher courses be given in the first few days of each new annual study period. At the time of the field work carried out by this author, the Unit 2 personnel were attending just such a training programme. All involved attended

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\*From Provisional 1970 Census Data of State Populations, June 1970.

regularly and seemed to be benefiting from stimulating problem discussion as well as from the learning process of the instruction periods.

Concurrent with the rehabilitation repayment scheme and the training programmes of Unit employees to aid in the growth of ejidatarios' outputs, there is the Hydraulic Plan for the Northwest (PLHINO). The idea behind PLHINO is somewhat similar to the task of transporting water to southern California from as far distant as Washington State. Simply stated, there is a shortage of water in the middle and northern Sonoran schemes yet there is an abundance of level usable land. In southern Sinaloa there is an over-abundance of water but no sizeable level plain that would be good for large scale agricultural development. The PLHINO scheme calls for the diversion of the south's surplus water supply to the needy north where it is required for agricultural development and mere expansion of the existing facilities, so tight is the balance between demand and supply.

The plan, inaugurated in 1965, is expected to be finished and in operation by 1980. From the Piaxtla River in southern Sinaloa northwards, 17 rivers' flows will finally be regulated and harnessed for the cultivation of an additional 426,000 hectares and for the generation of electricity. The estimated cost is 5,440 million pesos which is split 4,520 million for irrigation costs, 315 million for flood controls and 605 million for power generation facilities. It is planned to divert water as far north as Guaymas, and clever selection of dam sites and conduction canal routes means there will be no need for pumping the water. To date, the agency in charge of much of the planning and construction of the required dams and canals is CRF. Based right in the centre of the proposed continuous expanse of irrigated land that will be the outcome of PLHINO, Los Mochis seems an obvious choice for coordination of this complex development.

Intimately related to the PLHINO is the implementation of PLAMEPA, the scheme directed at improving plot efficiency particularly

with respect to the reclamation of wasted water. Research is also being carried out in shrimp breeding, along the lagoon coastline of the Fuerte District. In tests over the last couple of years, sections of lagoons have been closed off to tides. In the artificial ponds the shrimps have bred under semi-laboratory conditions and have thrived, protected from predators. A system of leasing lagoon areas to ejidatarios is proposed so that they may augment their incomes from trade with this valued export commodity.

Although the CRF is now more immediately concerned with assisting the ejidal sector than initially, there is still a marked concentration of this agency's financial and manpower resources on aqua-engineering projects. It should, however, be noted that there is now a more complete development framework within the area and it is doubtful whether there is as well served an agricultural area in Mexico as the Fuerte District with respect to water, power, seeds, transport, market contacts, extension services, research facilities, agro-industries and services and even credit. It will be instructive to observe over the next 5-10 years how effective the newly organized Sinaloan Department of Agriculture (DAES) is in helping the ejidal farming sector to improve its usage of the available resources.

CHAPTER III

## THE FARM CHARACTERISTICS OF THE FUERTE SCHEME

Main Tenure Groups, their Land Distribution and Quality

It is now necessary to examine the tenure characteristics and the distribution of the Fuerte farmers' land in order to understand the system of production in the District, and to establish what broad performance differences exist between the ejidal and private sectors.

As stated previously, District No.75 is divided by the CRF into five main Units, all of which are fed with water by gravity, while in addition there are small areas north of the Canal Del Fuerte, bordering on Unit 1, 2, and 3, which are fed by pumped water from that canal. These small areas are referred to respectively as Zone 13 and Zone 14. To the east and north of the central area of the District is located one other irrigated location named El Fuerte-San Blas, between the two villages of the same names, where both gravity and pumped irrigation water are used. Units 1-4, Zones 13 and 14, and El Fuerte-San Blas are all supplied by the Canal Del Fuerte, while Unit 5, on the northern side of the river delta, is supplied by the Canal Cahuinahua (see Map 2).

The Unit sizes (1970) range from 38,966 hectares for Unit 4 to 57,225 hectares for Unit 3. These dimensions are the gross area figures, including all land whether it be irrigable or not, whether it be salty or unlevelled. The details of the Units and Zones are indicated in Table IX. The data presented in this Table can be further broken down into the main tenure groups to give an indication of the relative importance of the private properties, the ejidos and the colonos. (see Table X).

The characteristics of the land in the tenure groups shown in

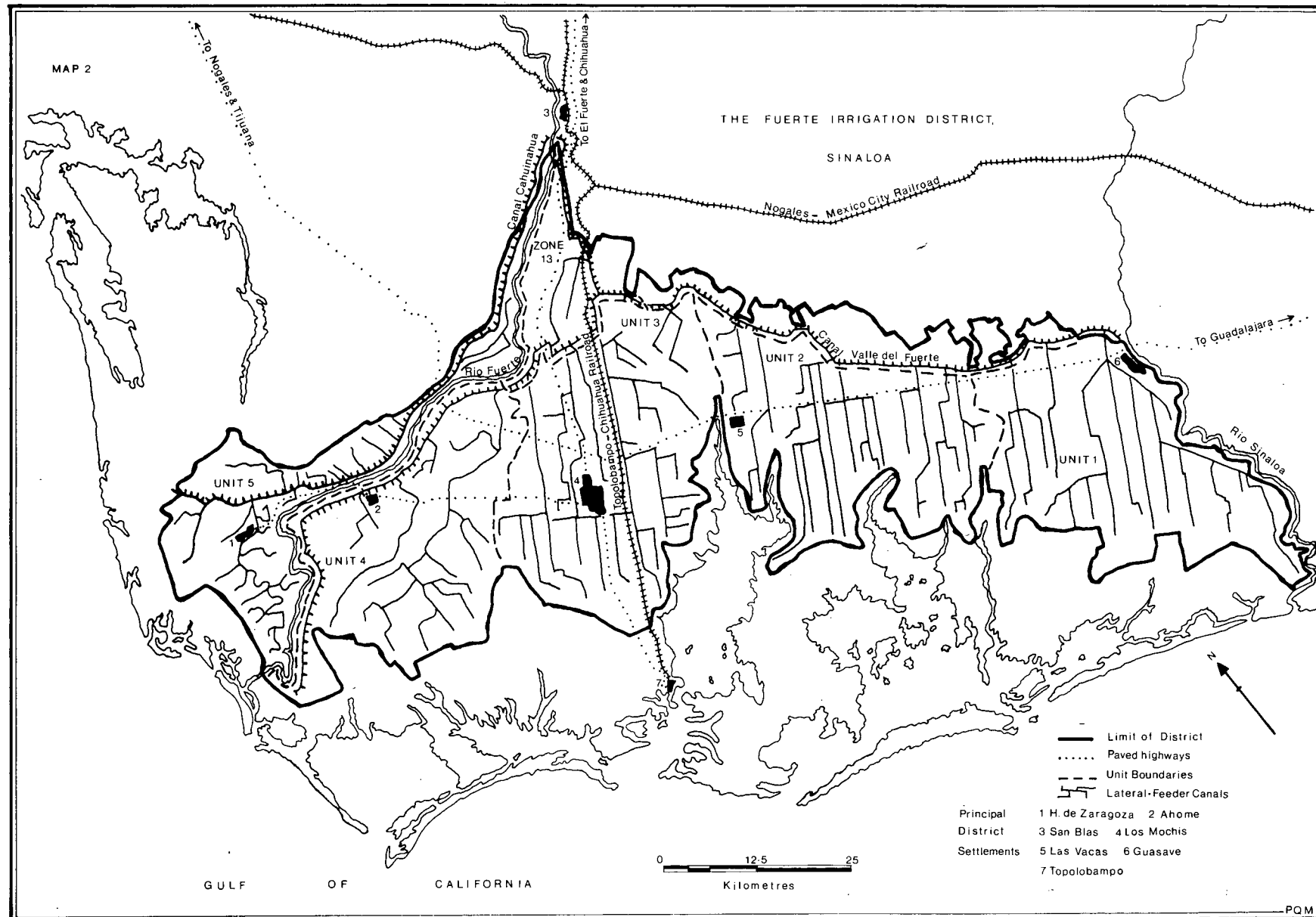


Table IX Dimensions of Fuerte District, Units & Zones, 1969/70  
(hectares)

	Gross Area	Irrigable	Salty & Unlevelled	Annexed
Unit 1				
Unit 1	43,568.81	33,502.84	6,874.29	3,191.68
Unit 2	57,166.33	42,957.10	3,084.67	11,124.56
Unit 3	57,225.95	50,188.00	2,571.34	4,466.61
Unit 4	38,966.88	20,944.24	16,604.16	1,418.48
Unit 5	40,138.32	15,322.76	11,522.81	13,292.74
Sub Total	237,066.29	162,914.94	40,657.27	33,494.07
Zone 13	15,617.63	12,800.10	1,716.91*	1,100.62
Zone 14	10,563.85	5,819.10	4,744.75	--
El Fuerte/San Blas	56,862.04	4,603.04	7,380.00	45,376.00
District	320,109.81	186,137.18	54,498.93	79,970.69

\*Unlevelled only.

Table X Dimensions of Fuerte District, Units & Zones by Tenure  
Groups, 1969/70  
(hectares)

	Gross Area	Irrigable	Salty & Unlevelled	Annexed
Unit 1 Private (P)	15,721	12,404	2,724	573
Ejidal (E)	27,847	21,098	4,131	2,617
Unit 2 (P)	25,310	22,475	599	2,234
(E)	28,558	17,291	2,467	8,799
Colono	3,297	3,190	17	90
Unit 3 (P)	14,139	12,634	750	753
(E)	40,086	37,553	3,715	1,817
Unit 4 (P)	12,078	8,376	4,237	363
(E)	25,988	12,567	5,868	1,054
Unit 5 (P)	11,263	7,313	3,079	869
(E)	28,874	8,009	4,049	12,422
Sub Total (P)	79,412	63,204	11,414	4,793
(E)	154,355	96,520	19,224	28,610
Zone 13 (P)	11,588	10,374	624*	589
(E)	3,525	1,925	1,092*	507
(C)	503	499	--	4
Zone 14 (P)	160	160	--	--
(E)	10,403	5,658	4,744*	--
El Fte/Sn Bl. (P)	1,611	1,611	--	--
(F) (E)	55,250	2,991	6,883	45,376
District (P)	92,772	75,350	12,038	5,382
(E)	223,633	107,094	31,944	74,493
(C)	3,800	3,689	17	94

Source:- Compiled from CRF data, July 1970.

\*Unlevelled only.

Table  $\bar{X}$  can be summarized in the following manner. In June 1970, the private properties contained respectively 33.6% and 22.7 per cent of the District's total area in salty (ensalitrado) and unlevelled (enmontado) land. The ejidos, for their part, held respectively 63.1 per cent and 77.2 per cent, while the respective breakdown for annexed land (anexiones) was 14.3 per cent and 85.4 per cent respectively for the private and ejidal sectors; the slight difference in the combined percentage totals is accounted for by the presence in Unit 2 of the Colono sector, of virtually no significance when the whole District is being considered. In other words, 20.4 per cent of the total private properties' lands are salty, unlevelled and annexed, while 37.4 per cent is the equivalent figure for the ejidal lands.

From the data available it appears that the ejidal sector overall suffers from land salinity more than does the private sector, and, overall, the ejidal sector is worse off with regard to land out of use by high salinity, land tied up in annexation difficulties, and land unused because it is not levelled.

Salinization of land took place quite rapidly and extensively in the District almost as soon as large-scale irrigation began in the cycle of 1956/57. The areas first affected by salt accumulation were located adjacent to the shoreline, in Units 1-5. This was primarily due to the rise of the already high water table as drainage waters from the District became trapped near the tide-water areas. The drainage waters at this time were high in saline content owing to over-irrigation of the District land, much of which was being worked for the first time after clearance of desert scrub cover. Unfortunately many of these coastal strip areas were held by ejidatarios. In 1964, almost one third of the entire District was in immediate danger of going out of production because of salt accumulations, so a large investment was made, financed through the Mexican banks and the government, who had received funds from AID and IBRD. Massive open drains, 20 metres wide by 10 metres deep, were excavated crossing the worst hit areas, located primarily in Units 2-4, and within a space of three years,



80 per cent of the most damaged land was coming back into productive use again.

Salinity problems do, of course, still exist, but areas affected by them are now under control and diminishing, and are fewer than areas in the unlevelled and annexed categories. The unlevelled land can be described merely as land that, to date, has not been prepared for cultivation and can be easily distinguished from the surrounding cultivated areas by its characteristic scrubby xerophytic vegetation cover. For certain operational reasons it has not been worth the private farmers' labour and expense to put the unlevelled land into use, given their existing land supplies, while in the case of the ejidatarios they have not acquired enough financial aid to clear and prepare the land, even if they wanted to do so.

The annexed land consists of those areas that are under dispute regarding their legal ownership and title, and that have been claimed by one tenure group or another. The land has not been prepared and put to productive use, primarily because the government agencies involved have not yet awarded the official "deeds". This idle land, in the ejidal case particularly, is especially unfortunate and wasteful, since the annexed area for the whole District represents 18.5 per cent of their total land holding. Even in the private sector it registers 6.0 per cent, which is still a considerable area (4,793 ha. private, 28,610 ha. ejidal). It appears that the well-aided assertion that the Mexican ejidal sector has more than its share of poor or damaged land is true in the case of the Fuerte Valley, Sinaloa. It should be recalled that the ejidatarios here had to wait upwards of 35 years for "ownership" of potentially productive land in this area of the Sonoran Desert!

It is now opportune to turn to the examination of the holding sizes of the tenure groups at a more detailed level to ascertain the respective uses of their land.

The distribution of farmers by tenure membership and size of holding is given in Table XI. The data have been grouped into

Table XI District Farmers Grouped by Property Size, 1969/70

Private	Units 1-5	Zones 13 & 14	El Fte/Sn B1
0-5 hectares	597	6	50
5.1-10	291	4	16
10.1-20	242	27	7
20.1-30	172	11	6
30.1-40	104	11	7
40.1-50	230	45	6
50.1-100	536	89	7
+ 100	33	1	--
Total	2,205	194	99
Colono			
0-5	3	--	--
5.1-10	197	1	--
10.1-20	31	14	--
20.1-30	7	11	--
30.1-40	2	--	--
40.1-50	3	1	--
50.1-100	6	--	--
+ 100	--	--	--
Total	249	27	--
Ejidal			
0-5	2,220	319	477
5.1-10	10,710	422	161
10.1-20	745	70	18
+ 20.1	--	--	--
Total	13,675	811	657
Total Overall	16,129	1,032	756

Source:- Compiled from CREFadata, July 1970.

three sections, Units 1-5, Zones 13 and 14, and El Fuerte-San Blas because it is felt that presentation of this material at the District level hides too many of the important variations in land endowment. It should be noted how small the colono sector is compared with the private and ejidal groups, and, as can be seen from Table XII, the colono type of exploitation is found only in Unit 2 and Zone 13. For the purposes of this study, the colono group was not examined, except in the later discussion on the production aspects of wheat, carried out in Unit 2. Otherwise, this farming group was ignored since its numerical significance for the District was so slight.

From Table XII it can be seen that when the farms are grouped by size, their distribution is concentrated. For instance, 78 per cent of the ejidal farms are in the 5.1-10 hectare range, 27 per cent of the private farms in the 0-5 hectare range and 24 per cent of them in the 50.1-100 hectare range. That is to say, the ejidal section is predominantly concentrated in the middle scale of the very small holdings while the private section is concentrated at the bottom end of the small holdings scale and also at the top end. The data given here, of course, take no account of renting out of land by ejidatarios to other ejidatarios or to private property operators. The data are the only type available from any source, and it is unfortunately not possible to give a more operationally realistic picture. The only information concerning renting was gleaned from individual farmers and the Comisión, and was no more precise than that given by Haissman (see Chapter IV, 86) where between 30 and 50 per cent of ejidal land was estimated as being rented out.

Table XIII gives the size of the farms by tenure group for the District's sub-divisions, highlighting the big differences between sub-area farms. At the same time the farm sizes are broken down into gross area and irrigable area. The gross area includes unlevelled and salty land, which is nonetheless registered under individual ownership. Clearly Unit 2 is outstanding as having the largest, officially registered private and ejidal operations

Table XIII District Farmers Grouped by Property Size for Sub-Divisions, 1969/70

	Unit 1		Unit 2		Unit 3		Unit 4		Unit 5		Zone 13		Zone 14		El Fte Sn. Bl	
<u>Private</u>																
0-5 hectares	86	19%	4	1%	95	25%	130	28%	282	49%	3	2%	3	50%	50	50%
5.1-10	63	14%	2	0.5%	51	13%	81	17%	94	17%	4	2%	-	-	16	16%
10.1-20	60	13%	100	3%	56	14%	73	15%	43	8%	26	14%	1	17%	7	7%
20.1-30	36	8%	23	6%	29	7%	440	8%	444	8%	11	6%	-	-	6	6%
30.1-40	34	7%	17	4%	13	3%	222	5%	18	3%	11	6%	-	-	7	7%
40.1-50	49	11%	92	26%	32	8%	35	7%	22	4%	44	23%	1	17%	6	6%
50.1-100	102	23%	201	57%	92	24%	86	18%	55	10%	88	46%	1	17%	7	7%
+ 100	3	0.7%	1	0.2%	12	3%	4	0.8%	13	2%	1	0.5%	-	-	-	-
Total	433	100%	350	100%	380	100%	471	100%	571	100%	188	100%	6	100%	99	100%
<u>Colono</u>																
0-5	-	-	3	1%	-	-	-	-	-	-	-	-	-	-	-	-
5.1-10	-	-	197	79%	-	-	-	-	-	-	1	3%	-	-	-	-
10.1-20	-	-	31	12%	-	-	-	-	-	-	14	52%	-	-	-	-
20.1-30	-	-	7	2%	-	-	-	-	-	-	11	41%	-	-	-	-
30.1-40	-	-	2	0.8%	-	-	-	-	-	-	-	-	-	-	-	-
40.1-50	-	-	3	1%	-	-	-	-	-	-	1	3%	-	-	-	-
50.1-100	-	-	6	2%	-	-	-	-	-	-	-	-	-	-	-	-
+ 100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	249	100%	-	-	-	-	-	-	27	100%	-	-	-	-
<u>Ejidal</u>																
0-5	728	22%	105	5%	619	13%	296	13%	472	27%	179	49%	140	31%	477	72%
5.1-10	2,442	76%	1,738	94%	3,478	76%	1,923	83%	1,129	66%	118	32%	304	68%	161	24%
10.1-20	34	1%	6	0.3%	492	11%	92	4%	121	7%	69	19%	1	0.2%	18	2%
+ 20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.2%
Total	3,204	100%	1,849	100%	4,589	100%	2,311	100%	1,722	100%	366	100%	445	100%	657	100%

Source:- Compiled from CRF data, July 1970.

Table XII Average Farm Size, Gross (a) & Irrigable (b) in District,  
1969/70  
(hectares)

	Private		Ejidal		Colono	
	a	b	a	b	a	b
Unit 1	28.65	36.31	6.59	8.69	--	--
Unit 2	64.22	72.32	9.35	15.45	12.81	13.24
Unit 3	33.25	37.21	8.18	9.39	--	--
Unit 4	17.78	27.36	5.44	11.25	--	--
Unit 5	12.81	19.73	4.65	16.77	--	--
Zone 13	55.19	61.64	5.26	9.63	18.52	18.66
Zone 14	26.79	26.79	12.72	23.38	--	--
El Fuerte/San Blas	16.28	16.28	4.55	84.10	--	--
District (Units 1-5)	28.66	36.01	7.06	11.29	12.81	13.24
District Overall	30.16	37.14	7.07	14.76	13.37	13.77

Table XIV Crop Activities of District Sub-Divisions, 1969/70

	Areas Sown ( '000has)		Area Harvested ( '000has)	Value per ha (Ps/ha)	Total Value of Production ( '000pesos)	
Unit 1	28.886	13.19%	28.117	3,167	91,494.4	9.78%
Unit 2	60.185	27.59%	59.377	5,716	344,041.7	36.91%
Unit 3	65.960	29.19%	51.748	3,886	256,351.6	27.51%
Unit 4	24.765	11.49%	19.911	2,359	58,413.3	6.26%
Unit 5	16.999	7.15%	16.617	2,409	40,951.4	4.37%
Zone 13	14.458	6.12%	14.107	4,178	60,402.1	6.46%
Zone 14	7.427	3.81%	7.404	10,146	75,357.3	8.09%
El Fuerte/San Blas	2.040	0.95%	1.933	2,312	4,717.0	0.57%
District	220.722	100%	199.085	4,221	931,729.3	100%

Source:- Tables XII & XIV compiled from CRF data, July 1970.

of Units 1-5, and the data in Table XIV and XV reveal that Unit 2 is outstanding in many other important respects. For example, Unit 2 with 27.59 per cent of the sown area of the District generates 36.91 per cent of the District gross production value, while at the other extreme are Units 1 and 4 (see Table XIV).

#### Distribution of Sown Area Among Tenure Groups

Table XV gives details of areas sown, harvested, value of output per hectare and total production values. For this Table, and elsewhere unless otherwise specified, measurements of area sown, area harvested, and output value are all aggregates for total agricultural production. That is, the data represent the sub-area breakdowns for all agricultural activities, and as far as this District is concerned that is crop cultivation. Livestock activities, for either meat or milk production, are not included within the aggregates because they are an insignificant agricultural activity in the District. Table XV even at its quite high level of data aggregation gives an illustration of the area/value imbalances existing in Units and Zones.

An elaboration of Table XV is given in Table XVI, where data have been reduced to the tenure group level for the Units. This is done in order to understand which groups of farmers are performing best within the Units. The situation is now considerably less simple and clear cut. In the case of Unit 2 the ejidatarios produce a higher value of output per hectare than the private sector, as do they also in the cases of Units 1, 4 and Zone 13. In the remaining areas of Units 3, 5, Zone 14 and El Fuerte-San Blas, the value per hectare of crops in private properties betters those of the ejidatarios. The exceptionally high value per hectare for Zone 14 can be understood in the light of that area's specialization in tomato cultivation by both tenure groups, where the average value generated per hectare is around 102,000 pesos! That exception aside, the normal cultivations of the other areas are in crops, cotton, sugar cane, soya, sorghum, wheat and rice, and these crops, of course, command lower yield values and lower weight yields, and hence depress their growers' rewards per hectare.

Table XV Crop Activities of District Sub-Divisions by Tenure Groups, 1969/70

		Area Sown ( '000has)		Area Harvested Harv ('000Has)	Value per hectare (pesos/ha)	Total Value of Production ( '000s pesos)	
Unit 1	Private(P)	12.883	44.17%	12.12	596	39,736.4	43.39%
	Ejidal(E)	16.002	55.11%	15.521	3,324	51,758.0	56.52%
Unit 2	(P)	38.736	64.24%	38.153	5,319	206,049.5	59.31%
	(E)	21.450	35.38%	21.223	6,433	137,992.2	40.38%
Unit 3	(P)	17.642	26.49%	15.626	4,135	72,951.8	28.12%
	(E)	48.317	73.51%	36.121	3,796	183,399.8	71.14%
Unit 4	(P)	10.736	43.87%	8.757	2,311	24,808.1	42.27%
	(E)	14.028	56.13%	11.154	2,396	33,605.2	57.31%
Unit 5	(P)	8.991	52.15%	8.660	2,438	21,919.0	53.21%
	(E)	8.007	47.85%	7.956	2,377	19,032.4	46.19%
Zone 13	(P)	12.468	86.89%	12.157	4,154	51,788.5	85.47%
	(E)	1.989	13.11%	1.950	4,331	8,613.6	14.16%
Zone 14	(P)	0.227	3.47%	0.217	20,581	4,671.8	6.15%
	(E)	7.199	96.53%	7.187	9,819	70,685.5	93.60%
El Fte/Sn B1	(P)	11.545	75.46%	1.456	2,416	3,733.4	79.69%
	(E)	0.495	24.54%	0.477	1,987	983.6	20.40%
District	(P)	103.233	46.77%	97.484	4,123	425,658.8	45.63%
	(E)	117.491	53.23%	101.600	4,307	506,070.5	54.37%

Source:- Compiled from CRF data, July 1970.

Table XVI Crop Activities of District Sub-Divisions at 1st & 2nd Cultivation Periods  
by Tenure Groups, 1969/70

		1st Cultivation		2nd Cultivation	
		% of Area	% of Value	% of Area	% of Value
Unit 1	Unit as % of District(U)	15.01	10.34	7.20	7.16
	Private in Unit(P)	40.09	38.60	69.24	78.90
	Ejidal in Unit (E)	59.91	61.40	30.76	21.11
Unit 2	(U)	26.09	37.36	29.14	34.68
	(P)	58.33	56.70	79.02	81.60
	(E)	41.67	43.30	20.98	18.40
Unit 3	(U)	31.04	26.04	25.53	35.04
	(P)	25.09	26.20	32.04	34.20
	(E)	74.91	73.80	67.96	65.80
Unit 4	(U)	11.03	6.17	11.15	6.75
	(P)	42.12	40.30	45.28	52.00
	(E)	57.88	59.70	54.72	48.00
Unit 5	(U)	7.01	3.68	9.34	8.00
	(P)	51.09	52.80	55.13	56.90
	(E)	48.91	47.20	44.87	43.10
Zone 13	Zone as % of District(Z)	6.03	6.77	7.39	4.98
	(P)	83.01	84.80	93.24	93.80
	(E)	16.99	15.20	6.76	6.20
Zone 14	(Z)	3.05	9.10	3.27	2.19
	(P)	1.29	5.70	7.06	9.20
	(E)	98.71	94.30	92.94	90.80
El Fte/Sn Bl - as % of District		1.01	0.51	0.52	0.47
	(P)	71.12	75.80	98.21	99.26
	(E)	28.88	24.20	1.79	0.74
District	(P)	43.10	43.10	56.00	59.00
	(E)	56.90	57.00	44.00	40.10

Source:- Compiled from CRF data, July 1970.



### Tenure Groups' Performance at 1st and 2nd Cultivations

In order to crack all aspects of the "production nutshell", it is necessary to break down further the data of Table XVI . The results of this are shown in Table XVII, where separate entries have been calculated for the tenure groups for the 1st and 2nd cultivation periods.

At the Unit level in the 1st cultivation period, Unit 2 and Zone 14 emerge as clear leaders in terms of producing considerably more of the District's 1st cultivation value than their respective area-sown proportions. The case of Zone 14 can be explained by referring back to the comments made earlier on its tomato specialization. Unit 2, however, cannot yet be explained and all that can be postulated at this stage is that the Unit performs much more efficiently and intensively than the others, assuming that it does not enjoy significant crop price advantages. At the 2nd cultivation period the picture is less obvious. Unit 2 still maintains a good share of the total value from its land input, but in this period it is bettered by Unit 3. Consistently throughout, Unit 4 performs poorly, having significantly lower values at both cultivations in relation to its share of land. Other things being equal, this may be due to unwise selection of crops on the part of that Unit's farmers who are cultivating low value crops at both times.

At the tenure group level, performance consistencies are more distinct. At the 1st cultivation, although one group does slightly better than another within its Unit and although it is the ejidal group that more often is superior to the private group, the degree of superiority of performance is very small indeed. At the 2nd cultivation, however, the private group in all cases produces crops whose values are proportionately greater than its areal share of land though less so in Units 5, Zone 13 and El Fuerte-San Blas. At their 1st cultivation the private properties, whose average size exceeds the ejidos by upwards of three times, probably maintain fair agrarian practices and rely on average returns to scale rather than high operational efficiency, while at the second period the private farmers intensify their cropping procedures and cultivate

Table XVII Average Gross Harvest Values per Farmer for District & Sub-Divisions by Tenure Groups, 1969/70 (pesos)

		Av. Value per farmer	Av. Value per ha., 1st cultivation	Av. Value per ha., 2nd cultivation
Unit 1	All Unit Farmers (U)	5,257,157	2,124	2,251
	Private (P)	91,770	3,352	1,873
	Ejidal (E)	16,154	3,352	1,873
Unit 2	(U)	140,540	--	--
	(P)	588,713	6,365	3,280
	(E)	74,631	7,117	2,874
Unit 3	(U)	51,590	--	--
	(P)	191,978	4,430	3,452
	(E)	39,965	4,164	2,885
Unit 4	(U)	20,997	--	--
	(P)	52,671	2,460	1,890
	(E)	14,541	2,714	1,433
Unit 5	(U)	17,859	--	--
	(P)	38,387	2,511	2,292
	(E)	11,053	3,355	2,192
Zone 13	All Zone Farmers (Z)	103,062	--	--
	(P)	240,877	5,321	1,751
	(E)	23,534	4,766	1,687
Zone 14	(Z)	167,089	--	--
	(P)	778,640	50,643	2,922
	(E)	158,844	12,401	2,207
El Fte/Sñ B1	All Farmers	6,239	--	--
	(P)	37,711	2,435	2,342
	(E)	1,497	1,992	1,350
District	(D)	49,057	--	--
Units 1-5	(P)	148,926	4,582	3,025
	(E)	31,136	4,331	2,531
District	(D)	52,003	--	--
All Areas	(P)	153,446	4,685	2,854
	(E)	33,419	4,796	2,498

Source:- Compiled from CRF data, July 1970.

higher value-yielding crops, while the standards of the ejidatarios decline. This may well be a function of the private property owners' higher educational training, better availability of operational and fixed capital and their greater awareness of market demands than their neighbouring ejidatarios. Undoubtedly in some cases these advantages seem to explain the different production responses of the two groups at the second cultivation period, but for all cases this is as yet only a surmise. Table XVII with its absolute values, like Table XVI with its proportionate values, reveals that the private sector in the second period of cultivation invariably betters the ejidal sector in performance. The effect of farm scale difference is evident in column one of Table XVII, where the average value of crop generated per farmer is calculated for the Units and by tenure groups. The effect of returns to scale is removed in the other two columns where calculations are measured on a per hectare basis. Nonetheless, it is instructive to note in column one the magnitude within Units of tenure group differences. The data in column one could be considered as a very crude measure of gross income of the farming types.

#### Imbalances between Tenure Groups and between Units in Terms of Crop Values Generated

The salient points presented are now summarized and shown in Tables XVIII and XIX. In the case of Unit 2, Table XVIII shows that 14.02 per cent of the District's private farmers, Unit 2's total population for that category, sow 37.06 per cent of the privately held land in the District, and from it produce 48.23 per cent of the private harvest crop value of the District. The data are thus presented in such a form as to make possible an assessment of the variations from Unit to Unit of the relative performance of the private and of the ejidal tenure groups. From the data, Unit 2 for both tenure groups appears to perform outstandingly, while Units 4, 5 and 1 do noticeably much worse for both tenure groups. The drawback of Table XVIII is, however, that it does not make possible an absolute assessment of the tenure groups. i.e. of private farms vis a vis ejidal. This difficulty is overcome in Table XIX.

Table XVIII Distribution of Farms, Area Sown, & Harvest Value for District's Sub-Divisions by Tenure Groups, 1969/70

		% Distribution of farm types	% Distribution of sown area	% Distribution of harvest value
Unit 1	Private(P)	17.33	12.05	9.15
	Ejidal (E)	21.15	13.07	10.12
Unit 2	(P)	14.02	37.06	48.23
	(E)	12.21	18.03	27.14
Unit 3	(P)	15.22	17.01	17.77
	(E)	30.32	41.02	36.13
Unit 4	(P)	18.86	10.04	5.36
	(E)	15.26	11.11	6.34
Unit 5	(P)	22.86	8.01	5.07
	(E)	11.37	6.09	3.39
Zone 13	(P)	7.53	12.01	12.84
	(E)	2.22	1.08	1.36
Zone 14	(P)	0.24	0.20	1.04
	(E)	2.94	6.02	13.97
El Fte/Sn B1	(P)	3.96	1.05	0.84
	(E)	4.34	0.40	0.15

Table XIX Sub-Divisions' Farms, Sown Area, & Harvest Values by Tenure Groups as Percentages of District with District Breakdown by Tenure Groups, 1969/70

		% of all District farms	% of District sown area	% of District crop value
Unit 1	Private(P)	2.42%	5.84%	4.26%
	(E)	17.88%	7.23%	5.56%
Unit 2	(P)	1.95%	17.55%	22.12%
	(E)	10.32%	9.72%	14.81%
Unit 3	(P)	2.12%	7.99%	7.83%
	(E)	25.61%	21.89%	19.68%
Unit 4	(P)	2.63%	4.86%	2.66%
	(E)	12.89%	6.36%	3.61%
Unit 5	(P)	3.19%	4.07%	2.35%
	(E)	9.61%	3.63%	2.04%
Zone 13	(P)	1.05%	5.65%	5.56%
	(E)	2.04%	0.90%	0.92%
Zone 14	(P)	0.03%	0.10%	0.50%
	(E)	2.48%	3.26%	7.59%
El Fte/Sn B1	(P)	0.55%	0.69%	0.40%
	(E)	3.67%	0.22%	0.11%
District	(P)	14.6%	46.17%	45.63%
	(E)	85.84%	53.83%	54.37%

Source:- Tables XVIII & XIX compiled from CRF data, July 1970.

The principal function of Table XIX is to highlight the large imbalances between the tenure groups' farmer populations and the crop values produced from their land areas sown. To take Unit 2 again, 1.95 per cent of the District's farmer population, representing all of the Unit 2's private operators, sow 17.55 per cent of the District's sown area to produce 22.12 per cent of the District's crop value. In sharp contrast is the case of Unit 1 where 17.88 per cent of the District's farmer population, representing all that Unit's ejidatarios, sow 7.23 per cent of the District's sown area to produce only 5.56 per cent of the District's total crop value! If one combines the tenure entries within a Unit or Zone, an accurate picture is given of the Unit's endowments and production. For instance, when this simple summation is applied to Unit 2 it is found that that Unit, with 12.27 per cent of the District's farmers and 27.27 per cent of the District's sown area, produces 36.93 per cent of the District's total crop value. The respective entries for Unit 1 are 20.30 per cent for population, 13.07 per cent for area sown and 9.82 per cent for value of crops produced.

#### Problems of Explanation, Measurement and Isolation of Crucial Variables - Some Solutions

At this point, some explanation might be expected to determine the effects of capital inputs, land endowments, labour inputs and machinery and equipment inputs in a Cobb-Douglas production function or formula, in order to understand the efficiency of the individual groups of farms (see Samuelson 1970, 7724). This might be desirable, but is not essential. Some of these tests might have been applied only to a sample of farms within one Unit, in this study's case, Unit 2. Nonetheless, although it is not possible through lack of sufficient data to say exactly which is or which are the most crucial variable(s) affecting the data in Table XVII, it is still instructive to look at the material in Tables XX and XXI.

Table XX clearly indicates the important variations in the intensity of land use from Unit to Unit and farming group to farming group. As would be expected from the relationships

Table XX Indices of Land Intensity & Indices of Cultivation  
Efficiency for District & Sub-Divisions by Tenure  
Groups, 1969/70  
(All crops)

		Intensity at 1st Cultivation <sup>1</sup>	Intensity at 2nd Cultivation <sup>1</sup>	Cultivation Efficiency Index <sup>2</sup>
Unit 1	Private(P)	0.80	1.04	0.97
	Ejidal (E)	0.69	0.76	0.97
Unit 2	(P)	1.00	1.72	0.98
	(E)	1.00	1.24	0.98
Unit 3	(P)	0.98	1.39	0.88
	(E)	0.96	1.29	0.74
Unit 4	(P)	0.95	1.28	0.81
	(E)	0.84	1.12	0.79
Unit 5	(P)	0.82	1.23	0.96
	(E)	0.69	0.99	0.99
Zone 13	(P)	0.81	1.20	0.97
	(E)	0.89	1.03	0.98
Zone 14	(P)	0.52	1.42	0.95
	(E)	0.95	1.27	0.99
El Fte/Sn Bl	(P)	0.77	0.96	0.94
	(E)	0.16	0.17	0.96
District Units 1-5	(P)	0.98	1.41	0.94
	(E)	0.88	1.12	0.85
District All Areas	(P)	0.95	1.37	0.94
	(E)	0.86	1.12	0.85

<sup>1</sup>Ratio of hectarage planted to hectarage available for planting.

<sup>2</sup>Ratio of harvested area to sown area.

Source:- Compiled from CRF data, July 1970.

established in the earlier Tables, Unit 22 shows up as the top performer by a clear margin for the private sector at both cultivations, and at the same time registers a good index level for the ejidal group. The measure given of cultivation efficiency interestingly shows an equal index figure for both the tenure groups in Unit 2; this measure may well be affected by extraneous factors such as water shortages and micro soil quality variations over which the farmer may not have much control, but the index does give a useful comparison.

Finally, in an attempt to measure the principal variables affecting the tenure groups' crop values, Table XXI was constructed. It has limitations, primarily that of not showing a break down as far as the Unit level, but constraints of time and finance prohibited such collection of reliable data. In any case, much of the data needed was destroyed yearly, and when a start was made on crop data collection by individual Units for tenure groups, it was soon found that adequate coverage existed for only some of the agricultural activities.

Table XXI shows, by value, the twenty-one principal crops cultivated in the Fuerte scheme. It also reveals the per hectare value of each main crop, indicating those which are potentially the most attractive to cultivate, assuming that market prices and yields, weight per hectare, are good and reliable. Table XXII expresses the price, yield and value of the ejidal sector's crops in terms of the private. The importance of the listed twenty-one main Fuerte crops is tabulated at the right for the ejidal group. The cumulative value of the twenty-one crops is 99.57 per cent and hence this crop coverage is completely representative of that tenure group's range of specializations.

From this Table, it is evident that the ejidal prices for the first ten crops do not vary greatly from those of the private sector, with the two exceptions of tomatoes and sorghum, the former being the crop of highest actual and potential value in the entire District! Lower down the column, however, the ejidos seem to do less well. Regarding yields, the ejidos have better results than

Table XXI Principal Crops of the Fuerte District by Descending Order of Value, 1969/70

	% of Total District Value	% of Crops' Value by Tenure Groups		Average Value per hectare harvested (pesos)
		Ejidal	Private	
1 Cotton	28.54%54%	68.54%	31.46%	5,986
2 Tomatoes	15.62%	44.72%	55.28%	46,270
3 Sugar Cane	10.37%	86.83%	13.17%	7,117
4 Sorghum	7.62%	48.71%	51.29%	2,739
5 Rice	7.13%	46.91%	53.09%	3,990
6 Wheat	6.89%	26.88%	73.12%	2,524
7 Soya	5.89%	28.06%	71.94%	2,832
8 Frijol (Beans)	5.12%	51.48%	48.52%	2,541
9 Maize (Cörn)	2.77%	54.08%	45.92%	1,845
10 Safflower	1.67%	74.89%	25.11%	3,266
11 Forrage flowers	1.39%	0.95%	99.05%	12,523
12 Potatoes	1.26%	46.96%	53.04%	7,259
13 Alfalfa	0.98%	56.76%	43.24%	5,406
14 Water Melons	0.77%	74.65%	25.35%	8,787
15 Canary seed	0.77%	19.47%	80.83%	3,489
16 Fruits	0.72%	0.42%	99.58%	12,071
17 Chile	0.59%	46.56%	53.44%	15,570
18 Sesame	0.35%	68.94%	31.06%	1,566
19 Melon	0.32%	00.64%	99.36%	7,758
20 Linseed	0.29%	73.78%	26.22%	3,211
21 Pumpkins	0.26%	22.31%	77.69%	14,696

Source:- Compiled from CRF data, July 1970.



the private holdings for 60 per cent of the first ten crops, and for 52 per cent of all the twenty-one major crops. Regarding value or harvest per hectare, the ejidos again have superior results over those of the private farms for 60 per cent of the first ten crops, but for all twenty-one major crops they have only 43 per cent superior entries. It would be foolhardy, however, to conclude that the ejidal farmers are considerably behind the private operators in value of harvest, since, although the data indicate that the ejidal sector does not match the private sector in these terms, the gap between the two groups is small. It ought to be recalled from the material already presented in this chapter how much variance exists in the "performance indicators" between the same tenure groups for different Units and Zones, and how these variances are masked in the District level data. It is not unreasonable to suppose that in the case of better Unit performers, like Unit 2 and 3, the differences in the tenure groups' value per hectare may be much smaller than those shown in the aggregate picture of Table XXII.

Summary of District/Unit/Zone Data for all Crops Grown and Assessment of Tenure Groups' Performances

The data therefore show the following points. The ejidal and private sectors hold claim to respectively 57.55 per cent and 40.48 per cent of the cultivable land in the Fuerte scheme, while the colono sector has a mere 1.97 per cent. When measured in terms of the gross land area held, the ejidal and private groups have respectively 69.84 per cent and 28.97 per cent of the scheme's area whilst the colonos have 1.19 per cent. The ejidal sector loses more potential sown area to salty and unlevelled land than the private group, and yet the farmer population of the ejidal sector is approximately six times as large as the other. Furthermore, the ejidal sector operates farms that are less than one quarter the average size of the private holdings yet the value per hectare sown is marginally greater for the ejidos. The margin, though, is very slim, and at the second cultivation the ejidal performance is consistently inferior to the private groups in terms of crop value

Table XXII Ejidal Crop Performance\* Compared to that of the Private Sector for the Major District Crops, 1969/70

	Rural Price	Yield	Value of harvest per hectare	% of total harvest value	
1 Cotton	+ 2.39%	+ 2.78%	+ 5.31%	35.98%	1**
2 Tomatoes	- 39.16%	+ 7.17%	- 34.80%	12.85%	3
3 Sugar Cane	=	+ 12.25%	+ 12.26%	16.57%	2
4 Sorghum	+ 39.86%	- 14.03%	+ 20.24%	6.83%	44
5 Rice	- 4.38%	+ 10.58%	+ 5.73%	6.16%	5
6 Wheat	+ 1.00%	- 8.90%	- 8.01%	3.41%	7
7 Soya	+ 2.19%	+ 11.36%	+ 13.28%	3.04%	8
8 Beans	- 2.91%	- 4.59%	- 7.37%	4.84%	6
9 Corn	=	- 15.94%	- 15.94%	2.76%	9
10 Safflower	- 0.60%	+ 6.35%	+ 6.28%	2.29%	10
11 Forrage flowers	=	- 18.57%	- 18.57%	0.02%	25
12 Potatoes	+ 10.25%	- 21.84%	- 13.34%	1.09%	11
13 Alfalfa	- 5.13%	+ 17.83%	+ 11.78%	0.98%	13
14 Water Melons	+ 16.12%	+ 12.03%	+ 22.83%	1.06%	12
15 Canary Seed	+ 14.66%	- 20.20%	- 8.50%	0.28%	177
16 Fruits	- 37.15%	- 74.67%	- 84.08%	--	28
17 Chile	- 25.49%	+ 24.13%	- 77.51%	0.50%	14
18 Sesame	- 7.26%	+ 6.62%	- 1.08%	0.41%	15
19 Melons	+120.22%	- 95.11%	- 35.83%	--	--
20 Linseed	- 7.43%	+ 12.64%	+ 4.27%	0.39%	16
21 Pumpkins	- 52.94%	- 4.13%	- 57.16%	0.11%	20

\* Ejidal data are expressed as positive (+), negative (-) or equal (=), in a percentile form compared to the Private sector's data.

\*\* Crop ranking by value for the ejidal group.

Source:- Compiled from CRF data, July 1970.

per hectare. At the second cultivation too, the private sector increases its proportion of the District's sown area by some 6 per cent, and the distribution of the sown area of the ejidal and private farms becomes respectively 53.23 per cent and 46.77 per cent; it is interesting to compare these figures with their shares of total workable District land of 57.55 per cent and 40.48 per cent.

Finally, gross imbalances are shown to exist between the tenure groups even at the District level with regard to farmer population, area sown and proportion of crop value generated (see Tables XVIII and XIX). The implication here is that there are too many ejidatarios dependent on too many small plots of 5.1-10 hectares (see Table XIII), and slightly inferior aspects of agricultural performance by the ejidal sector are magnified in their poor per capita harvest values. The ejidal sector does not appear to maximize its land resources as well or as intensively as the private sector, which has a great advantage in per capita resources, and hence a superior per capita value advantage, right at the outset.

In summary, the yield performance of the ejidal sector is good enough to match that of its competitor, the private sector. However, only if the ejidal sector intensifies the use of its poorer land resources and maintains higher operational efficiency, particularly at the second cultivation, will it be able to improve its weak per capita crop values, reducing the extent of the present value imbalance between the two main farming groups. The points tackled in this initial investigation, outlined earlier, are verified by the broad District data but it is noteworthy that many of the differences measured between the tenure groups are not large by any standards. Given the short time period covered by the available data, considerable caution must be exercised at this stage in drawing conclusions.

CHAPTER IV

## THE SAMPLE AREA - UNIT 2

The Choice of Unit 2 and Rationale for Wheat Cultivation Study

The principal aim of this study is to probe deeper than the data given at District level allow, with regard to the ejidatarios' agricultural activities in the Fuerte scheme. The presentation of previous data has shown that Unit 2 is outstanding as the best performer with respect to values generated per hectare of sown land, land use efficiency, and the intensity indices. In addition, this Unit possesses the largest productive farms, and the highest crop values per capita for both tenure groups.

As stated earlier, the author intends to test this paper's hypothesis through a farm sample study of the District's most productive and best rewarded farmers; hence the choice of Unit 2 on the basis of the Unit's farming characteristics as revealed in the previous chapter. The rationale behind this decision is straightforward. If, in a sample examination of the scheme's best farmers it can be shown that the ejidal farmers make a net financial loss on their crop activities, given certain interaction of the crucial input variables that most affect the ejidatarios' production costs, then it can be surmised with some justification, that farmers elsewhere in the scheme with similar inputs would also incur financial losses. Uneconomic farm operation is therefore a central interest here, as are the reasons behind such operations. The focus of attention is on the ejidal sector since this is the farming population group that was created by the Revolution, and it is the Revolution, broadly speaking, that is being looked at critically.

Where an examination of individual farms is to be undertaken,

it is necessary to consider selecting a sample population in which the members all cultivate at least one common crop. The crop selected here is wheat, the cereal crop that Mexico imported until 1964 when the massive output of the Northwest at last made itself felt, and when the joint research developments of CIANO/CIAS and Rockefeller paid off in the high-yielding, disease and drought-resistant dwarf hybrids bred specially for the arid states of Sonora and Sinaloa. This crop has undergone, during two decades, more rigorous scientific hybridization by extremely competent teams of agronomists, biologists and crop geneticists than any other at present under cultivation in the Northwest, including the Fuerte valley. Varieties like Lerma Rojo 64, INIA 66, CIANO F-67 and Noroeste 66 have made the Northwest the bread-basket of Mexico and brought much of the region's overall socio-economic gain from their earnings in the export and national market. Concomitant with this crop-research has been the formation of highly efficient quality controls over the distribution and sale of certified wheat seed.

In order to maximize the cultivation process, regional extension facilities are well advanced, especially those for wheat, and in the case of the Fuerte District, a well-run experimental and extension station is centrally located, in Unit 2, off the main highway between Los Mochis and Guasave. Agronomists and trainee field assistants work from this base (CIAS) serving the District's farmers, particularly the ejidatarios. Services including planting instructions, irrigation timings, number of water applications, seed spacing, fertilization, and fumigation are available free of charge to any farmer. Bulletins and cultivation schedules are circulated by this Field Experimentation Centre to the main ejidal settlements, and joint publications are likewise put out by CIANO with CRF.

The choice of wheat for farm examination purposes appears apposite, given the District's good availability of research, extension, and control of seed quality. Clearly, in an investigation

of this type, it is highly desirable to reduce the potential number of variables that may affect the outcome of the individual farmer's cultivation activities. If one farmer uses a certified hybrid seed and another uses a non-certified type, then there is little point in studying the two farmers from the point of view of ultimately being able to compare their output levels. They are using quite different seed inputs, hence a comparison of their production outputs would be totally meaningless and certainly an invalid attempt at controlled observation.

#### Wheat in Unit 2 and the District

Before looking at the sample farmers in Unit 2, it is useful to present briefly the wheat data for the District, and for the Units and Zones<sup>\*</sup>, giving a similar level of measurement and detail as was presented earlier for all agricultural activities, which here are synonymous with cropping.

The overall data for the District, the Units and the Zones are shown in Table XXIV, for the two cycles 1968/69 and 1969/70. Clearly Unit 2 is the main wheat grower and producer of the District. At the first cycle given, 1968/69, with 42.12 per cent of the District's wheat-sown area, Unit 2 produced 44.48 per cent of the District's wheat-crop value. With a high average yield of 3.303 kilo-tons per hectare and 800 pesos per ton rural price, Unit 2, excluding El Fuerte/San Blas which had an unusually high average price entry, registered the highest value per hectare sown of 2,642 pesos. The important points to be noted are the small range in the yields attained from Unit to Unit, from a minimum of 2.850 kilo-tons per hectare to a maximum of 3.303 kilo-tons per hectare, and the equally narrow spread of the rural price from 800 pesos per ton to 821 pesos per ton, again excluding the exceptional case of El Fuerte/San Blas with 913 pesos per ton. As a result of these two small spreads, the values generated per

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<sup>\*</sup>See Table XXIII for indices of areas sown and values of harvest for all crops and for wheat.

Table XXIV Analysis of Wheat Production of District & Sub-Divisions, 1968/69-1969/70

	Area Sown (hectares)		Area Harvested (ha)		Yield(Kilo- tons per ha.)		Production (Kilo-tons)		Price per ton(peso)s		Value per ha.(peso)		Total value ('000s peso)	
	68/69	69/70	68/69	69/70	68/69	69/70	68/69	69/70	68/ 69	69/ 70	68/69	69/70	68/69	69/70
Unit 1	3,521	2,958	3,403	2,905	2.850	3.067	9,701	8,887	800	804	2,280	2,465	7.761	7.139
Unit 2	10,855	7,594	10,850	7,484	3.303	3.041	38,845	22,940	800	800	2,642	2,432	28.676	18.352
Unit 3	4,716	3,220	4,644	3,193	2.956	3.335	13,727	10,658	821	815	2,426	2,718	11.284	8.650
Unit 4	1,589	469	1,589	469	3.000	2.480	4,769	1,240	801	800	2,403	1,984	3.818	0.992
Unit 5	82	31	82	31	2.900	1.000	237	31	800	850	2,320	850	0.190	0.026
Zone 13	3,570	3,341	3,565	3,341	3.152	2.973	11,236	10,034	800	809	2,521	2,405	8.988	8.042
Zone 14	693	544	693	544	3.118	3.500	2,160	1,094	800	800	2,494	2,800	1.728	1.532
El Fte/Sn B1	546	179	546	179	3.300	3,519	1,801	627	913	860	3,012	3,026	1.645	0.541
District	25,574	18,336	25,374	18,146	3.002	2.865	79,480	56,321	806	817	2,419	2,340	64.092	45.269

Source:- Compiled from CRF data, July 1970.

hectare by the sub-areas of the District are equally bunched together.

In the agricultural cycle 1969/70, the District experienced a 28.31 per cent drop in the area sown to wheat and a 29.37 per cent fall in the value of wheat produced compared to the previous year, 1968/69. This was primarily due to the government's lowering its minimum support price for wheat from 850 pesos per ton to 750. In Table XXIV we can see also that the main cultivator of this cereal crop, however, still remained Unit 2, producing 40.25 per cent of the District's wheat value from 41.08 per cent of the total wheat area of the District. In 1969/70 Unit 2 did not maintain its slightly superior yield level over the other producers, although, as in 1968/69, it kept ahead of the District average. This downward movement in Unit 2's broad "performance" indicators was accompanied by an upward movement in the indicators of Units 1 and 3 and El Fuerte/San Blas. Excluding Unit 5 which inexplicably has a disastrously bad yield, there was a wider spread of entries, ranging from a low of 2.480 kilo-tons per hectare to a high of 3.519. This factor coupled with the greater deviation from the rural price of 800 pesos per ton, led to the wider spread of entries in the value per hectare sown category.

Table XXV dissects these data into the two main tenure groups for the same agricultural time periods and shows the variations for the farming groups, and thus helps to illuminate the general picture of change portrayed in Table XXIII.

The data are presented by tenure groups in a more easily comparable form in Table XXVI, as percentages of District wheat area, production and value. Table XXVII also gives a proportional and comparative picture, the distinction being that the data are given as percentages of all farms of the District. Thus in 1968/69, all the Unit 2 private farms that sowed wheat represented 33.98 per cent of the District's total area sown in that crop and those farms produced from their share of the sown area 36.37 per cent of the total wheat crop value.



Table XXV Analysis of Wheat Production for District's Sub-Divisions by  
Tenure Groups, 1968/69-1969/70

		Area Sown (hectares)		Yield per ha. (kilo-tons)		Price per ton(pesos)		Value per ha. (pesos)		Value of output ( '000s pesos)	
		68/69	69/70	68/69	69/70	68/69	69/70	68/69	69/70	68/69	69/70
Unit 1	Private(P)	2,083	1,187	3,021	3,108	800	808	2,416	2,511	6.678	2.976
	Ejidal (E)	718	1,771	2,113	3,125	800	800	1,690	2,420	1.082	4.163
Unit 2	(P)	8,691	6,074	3,355	3,082	800	800	2,668	2,465	23.311	14.710
	(E)	2,164	1,520	3,098	3,000	800	800	2,471	2,400	5.364	3.641
Unit 3	(P)	2,164	1,234	3,033	3,322	807	830	2,447	2,757	5.117	3.399
	(E)	2,552	1,986	2,893	3,348	835	800	2,415	2,678	6.166	5.251
Unit 4	(P)	655	319	3,000	2,934	800	800	2,320	2,347	1.572	0.748
	(E)	934	150	3,000	2,026	801	800	2,403	1,620	2.246	0.243
Unit 5	(P)	58	31	2,900	1,000	800	850	2,320	850	0.134	0.026
	(E)	24	--	2,900	--	800	--	2,320	--	0.055	--
Zone 13	(P)	3,337	3,059	3,152	3,009	800	800	2,521	2,407	8.404	7.364
	(E)	232	282	3,144	2,936	800	819	2,515	2,404	0.584	0.678
Zone 14	(P)	--	--	--	--	--	--	--	--	--	--
	(E)	693	544	3,118	3,500	800	800	2,494	2,800	1.728	1.523
El Fte/Sn B1	(P)	546	166	3,300	3,500	913	865	3,012	3,027	1.645	0.502
	(E)	--	13	--	3,583	--	855	--	3,063	--	0.391

Source:- Compiled from CRF data, July 1970.

Table XXIII Indices of Total Sown Area & Harvest Value of All Crops & of Wheat for District, 1964/65-1969/70  
(1966/67 = 100)

	All Crops		Wheat	
	Area	Value	Area	Value
1964/65	78	65	180	166
1965/66	80	96	63	61
1966/67	100	100	100	100
1967/68	109	94	99	73
1968/69	99	94	91	86
1969/70	100	104	65	61

Table XXVI Sub-Divisions' Wheat Areas Sown, Production & Values by Tenure Groups as percentages of District's Tenure Group Totals, 1968/69-1969/70

		Area sown in		Production of		Value of Output	
		Wheat as % of		Wheat as % of		of Wheat as % of	
		District total		District total		District total	
		68/69	69/70	68/69	69/70	68/69	69/70
Unit 1	Private only (P)	15.69%	9.10%	14.19%	9.36%	14.12%	10.00%
	Ejidal only (E)	9.00%	28.17%	6.81%	26.16%	6.49%	26.12%
Unit 2	(P)	47.13%	50.04%	50.26%	49.29%	49.35%	49.14%
	(E)	29.41%	24.16%	31.13%	23.09%	31.24%	23.07%
Unit 3	(P)	11.16%	10.03%	10.52%	11.03%	10.43%	11.13%
	(E)	34.64%	31.44%	34.17%	33.16%	35.14%	33.12%
Unit 4	(P)	3.11%	2.08%	3.22%	3.19%	3.17%	2.15%
	(E)	12.56%	2.25%	13.05%	1.11%	13.67%	1.09%
Unit 5	(P)	0.30%	0.21%	0.25%	0.08%	0.24%	0.08%
	(E)	0.32%	--	0.36%	--	0.30%	--
Zone 13	(P)	18.57%	25.04%	18.16%	24.34%	17.44%	24.23%
	(E)	3.12%	4.31%	3.95%	4.05%	3.39%	4.06%
Zone 14	(P)	--	--	--	--	--	--
	(E)	9.34%	8.43%	10.39%	9.16%	10.01%	9.13%
El Fte/Sn Bl	(P)	2.18%	1.05%	3.54%	1.21%	3.24%	1.21%
	(E)	--	0.21%	--	0.21%	--	0.21%

Source:- Compiled from CRF data, July 1970. - Tables XXIII & XXVI .

Finally, in Table XXVIII, the ejidal sector's performance is expressed positively or negatively in relation to the performance of the private group in price, yields (kilo-tons per hectare), and value. It is seen that over these two years, which are the only two years of reliable data, the ejidal group did not enjoy any marked price advantage or disadvantage, but with regard to yield the peasant farmers improved their poorer performance and closed the gap considerably. This, of course, was in some measure aided by a fall in 1969/70 in the level of the private group's yield. The outcome, however, still shows the campesinos at a disadvantage vis a vis value per hectare, but, excluding the disastrously low entry for Unit 4, the extent of this disadvantage decreased in most cases by 1969/70.

#### The Unit 2 Tenure Groups and their Farm Holdings

As indicated previously, Unit 2 contains three tenure groups, private, ejidal and colono. This last group gained land in this Unit, as compensation for their holdings, often including chapparal land, located in the Miguel Hidalgo dam area. When the dam was finished in 1956 and the reservoir behind began to form, the pent-up waters for the Fuerte scheme flooded the colono holdings. The colonos were given 10 hectares of land for every 100 hectares of land that they had held and lost in the watershed area. As in the other tenure group cases, the first farmers had to clear their land on arrival in the area. Desert vegetation had been removed by the CRF but no other preparations had been made. This policy has been changed for the new El Carrizo scheme, but it is not clear whether this is because it has been designated for ejidatarios only! It must be remembered that the colono group legally own the land they were given in compensation. This is distinct from the land given to the ejidal sector, where the land is not legally owned by the recipients.

The private farming group in this Unit is distinguished by having, as noted in Chapter III, the largest farms in the District,

Table XXVII Sub-Divisions' Wheat Areas & Harvest Values by Tenure Groups as percentages of the District Totals, 1968/69-1969/70

		Wheat Area		Wheat Value	
		68/69	69/70	68/69	69/70
Unit 1 Private	as % of all farms (P)	10.96%	6.47%	10.42%	6.57%
Ejidal	as % of all farms (E)	2.81%	9.66%	1.69%	9.20%
Unit 2	(P)	33.98%	33.13%	36.37%	32.50%
	(E)	8.46%	8.29%	8.37%	8.04%
Unit 3	(P)	8.46%	6.73%	7.98%	7.51%
	(E)	9.98%	10.83%	9.62%	11.60%
Unit 4	(P)	2.56%	1.74%	2.45%	1.65%
	(E)	3.66%	0.82%	3.51%	0.54%
Unit 5	(P)	0.23%	0.17%	0.21%	0.06%
	(E)	0.09%	--	0.09%	--
Zone 13	(P)	13.05%	16.68%	13.11%	16.27%
	(E)	0.91%	1.54%	0.91%	1.50%
Zone 14	(P)	--	--	--	--
	(E)	2.71%	2.97%	2.70%	3.36%
El Fte/Sn B1	(P)	2.13%	0.91%	2.57%	1.11%
	(E)	--	0.07%	--	0.09%
District	(P)	71.07%	65.97%	73.08%	65.85%
	(E)	28.93%	34.03%	26.92%	34.15%

Table XXVIII Ejidal Wheat Crop Performance\* for District & Sub-Divisions Compared to that of the Private Sector, 1968/69-1969/70

	Rural Price		Yield		Value per ha.	
	68/69	69/70	68/69	69/70	68/69	69/70
Unit 1	=	=	0.99%	-33.06%	-2.67%	-30.05%
Unit 2	=	=	7.66%	-2.66%	7.38%	-2.66%
Unit 3	+ 3.47%	-- 3.61%	4.62%	+ 0.78%	1.31%	-2.87%
Unit 4	+ 0.13%	=	=	-30.95%	+ 0.13%	-30.95%
Unit 5	=	---	=	---	=	---
Zone 13	=	++ 2.38%	0.25%	-2.47%	0.25%	-0.12%
Zone 14	---	---	---	---	---	---
El Fte/Sn B1	---	-- 1.16%	---	+ 2.37%	---	+11.19%
District	+ 1.00%	---	- 6.85%	---	- 5.92%	---

\* Ejidal data are expressed as positive(+), negative(-), or equal(=), in a percentile form compared to the Private sector's data.

Source:- Tables XXVII & XXVIII Compiled from CRF data, July 1970.

and, within their number, contains 80 per cent of the credit Union of Corerepe's members, to be discussed later in this chapter. The private farmers here can be termed the "nouveau riche" of the Northwest, and of the Fuerte in particular. They should not be confused with the remnants of the old hacendado class. The private farmers have, at most, been in agriculture for twenty-five years, and almost certainly 90 per cent of them resident in the area had had no practical contact or experience with the operation of land prior to the opening of the Fuerte District. Although it was not possible to obtain data for the regional origins of these agriculturalists from the State Census materials, it is not unreasonable or unrealistic to suggest that upwards of 75 per cent of them came from the central upland settlements of Mexico, where they had been businessmen or professionals, and had had considerable experience in management and investment techniques of some kind or other. The remainder have come from neighbouring Chihuahua or Durango where they have left the failing cattle-ranching business. At the same time, these "neo-latifundistas" realized more than any others that there were good prospects of obtaining highly remunerative land resources in the Fuerte during the early 1950s, and that since the supply of land available to them was limited, they must secure as much as possible. It was at that time fairly easy to circumvent the restriction of 100 hectares per hoding by registering extra land in the names of relatives of the purchaser, or more recently in the names of employees.

To illustrate this aspect of land development, the case is taken of one of the District's most successful, and now influential private operators. This farmer-to-be flew Texans over the Northwest's developing irrigation areas in the early 1950s when U.S. farmers were keenly interested in obtaining land in Sonora and Sinaloa, although under the Mexican Constitution of 1917, it is illegal for foreigners to own Mexican land. When the Mexican pilot was offered a 100 hectare plot illegally bought by one of the Texans, he accepted it on condition that he repaid the Texan within five years.

This land was located on the Yaqui scheme, centred on Ciudad Obregón in Sonora, and on it the pilot cultivated wheat and cotton. The Texan was paid-off within the agreed time. The pilot quickly became involved in not only the formation of the early credit Unions, but also in the development of seed breeding and further land operation in the Northwest, namely here on the Fuerte in Unit 2. Today he is a Mexican millionaire, with residences in Los Mochis and Chihuahua, and in addition to his irrigated holdings on the Fuerte and Yaqui lands, he owns a 5,000 hectare cattle ranch near El Carrizo, northwest of the village of Taxtes.

In the main, his case is typical of the degree of progress and self-advancement that the large private holders of the Unit have achieved during the life of the Fuerte scheme. Those operators officially hold upwards of 50.1 hectares, though unofficially their average farm sizes are extremely difficult to gauge, but a reasonable estimate would be 200 hectares or over.

The second type of private operator in this Unit (and District) averages officially 20.1-50 hectares. This group consists of the farmers who left the central and southern areas of the nation when they heard of the Fuerte's construction. They sold their small holdings and bought smaller shares of irrigated land. They operate within the credit advantages of the larger members of their tenure group, and they aspire to further land purchase and membership of the big Unions. It can be assumed here in this Unit that a private operator officially owning only 20 hectares, has rented to him by others, usually illegally, ejidatarios, at least another 20 hectares of land. The ownership and upkeep of the machinery held by him (tractor, land leveller, harrowers, drillers) usually requires him to work additional land in order to reduce ownership costs of his capital equipment.

The third private type can be described as the minifundia variety, with, normally, from 0-10 hectares, but in this case for Unit 2 the span has been broadened to cover from 0-20 hectares, a somewhat higher limit than is usually placed on the term.

As indicated in Chapter III, only 16 operators even officially exist in this category for the Unit, and from the field work carried out for this District sub-area, it was found that these few official entries were in fact land purchases made by former ejidatarios, who were now members of two land tenure groups!

The ejidal structure of Unit 2 can best be appreciated in conjunction with the material presented in Table XXIX. Chronologically, Las Vacas (also known as Juan Jose Ríos) is the oldest ejidal settlement, and is apparently one of the biggest ejidos in the entire Mexican nation. The ejido was established prior to irrigation as a government effort at encouraging the flagging beef livestock industry. This had minimal success, primarily due to the oversight that there was insufficient natural pasture land for the cattle density required to support the farmers. Not surprisingly, the livestock activities were immediately abandoned when the water scheme started service in 1956. Bachoco, Las Parrítas and Corerepe were established on similar lines to those of Las Vacas, and they also changed to crop cultivation in 1956 for identical reasons.

The remaining ejidos of El Gallo, Hidalgo, Los Hornos, Jesus Marie, Miguel Alemán and Ruis Cortines No.2 are somewhat different. Excluding Ruis Cortines No.2, all the others are made up of farmers who applied for recognition as members of new ejidos, and hence for the possession of new (additional) land, doing so in the hope of enlarging their original dotation that was in the order of 4-6 hectares. In these instances, the ejidatarios received their desired 10 hectare plots except for El Gallo and Los Hornos. The problem as far as the El Gallo farmers are concerned is that land expected to be expropriated from the private sector has not become available and hence the present 4.5 hectare size of the plots. In Los Hornos the same situation existed, but here, since there was only enough land for half of the members to receive 10 hectares, rather than make do with 4.5 hectares the group members drew lots to decide who received land. The rather odd situation now exists

Table XXIX Characteristics of the Ejidos in Unit 2, 1969/70

Name	Farmer Population	Regional Source of resident farming population	Date of Formation	Av. size of usable holding(ha)
Bachoco	339	35% Zacatecas/Guanajuato 30% Los Mochis 25% Fuerte Watershed 10% Native	1950	9.5
Corerepe	236	100% Los Mochis	1954	10.0
El Gallo	46	100% Guasave	1956	4.5
Hidalgo	20	100% Guasave	1956	10.0
Las Parrítas	56	100% Guasave	1952	10.0
Los Hornos	14	100% Guasave	1956	10.0
Jesus Maria	44	100% Guasave	1960	10.0
Miguel Alemán	89	100% Guasave	1960	10.0
Ruiz Cortines No.2 *	119	33% Chihuahua 33% Sonora 33% Los Mochis/Guasave	1963	9.0
Ruiz Cortines No.3 *	53	40% Ahome/Zarragoza 60% Guasave	1963	4.5
Las Vacas	662	50% Fuerte Watershed 50% Los Mochis/Native	1946	9.0

\*Ejidos that have not yet received official recognition of their permanent existence. i.e. their occupancy of certain land areas.

Table XXX The Wheat Sample Population of Unit 2, 1969/70

Location	No. of farmers	Av. farm size - usable area, ha.
Bachoco	11	10.0
Corerepe	2	10.0
El Gallo	2	4.5
Jesus Maria	6	10.0
Miguel Alemán	4	10.0
Las Parrítas	11	10.0
Ruiz Cortines No.2	6	10.0
Las Vacas	109	10.0
Total Ejidal Sample	151	
Total Private Sample	102	
Total Colono Sample	58	
Total Farms Eligible for sampling	311	
Total Farms Actually sampled	305 (148 ejidal, 99 private & 58 colono)	

Source:- Tables XXIX & XXX Compiled from CRF Unit Office data, July 1970.



where some of the individuals who were unlucky and received nothing, live in the ejidal village and do yearly labour services for the ejidatarios who were fortunate and now possess 10 hectares... This has the effect of distributing income from those holdings more widely, but in practice the income is small and its effectiveness in raising living standards is virtually nullified.

A point worthy of consideration is that at any time prospective ejidatarios, (sometimes vagrant squatters), are entitled to apply in an organized group to SAG, or its local substitute, (here CRF in outlying areas), for land. If the land they wish is already in ownership, (private land being affectable land), then, unless it can be shown that the private land is being operated productively throughout the agricultural year, it will be expropriated and parcelled out to the applicants for its ownership, the squatter-ejidatarios. Often the time taken over the assessment of the "productive" aspect of the land in question runs into several years, and frequently as a result, the would-be owners give up and move on somewhere else. As the region's peasant population increases, very rapidly, estimated at 5.6 per cent per annum, the pressure on any type of available land increases, and the private operators are only too aware of the constant threat of expropriation of their lands. They are legally not protected particularly effectively by the Revolution's Agrarian Laws, and it is thanks only to the common sense of the area's officials that more expropriation of highly productive private holdings has not occurred, to be given to squatters with no known farming abilities.

Finally, there is the distinctive case of Ruis Cortines No.2. Its farmer population make-up is regionally diverse, this being a reflection of the fact that these ejidatarios, prior to their group consolidation, worked as farmhands on local private properties gaining useful experience and skills. Armed with their first-hand knowledge of the sub-area and modern irrigation agriculture, they now have 9 hectares per capita of usable land. This ejidal group did not have previous "ownership" of land in the scheme as

did most of the members outlined in the above five cases.

Table XXX shows the population of the samples taken of the three tenure groups. The ejidal samples are detailed by village. It is not possible to locate the private and colono group populations in terms of village locales out of which the respective farmers work. Quite simply, this is because the majority of the colonos, and all the private farmers live in either Los Mochis or in Guasave. Nonetheless the location of the wheat plots sampled are shown on Map 3.

#### The Farm Sample: The Data and Basic Findings

The sample farms of Unit 2 were selected from among those farms growing wheat in 1969/70. In the examination, therefore, a sample of Unit 2's farmer population is being considered, but that sample represents the total Unit population of farmers cultivating wheat. It should be noted that for 85.47 per cent of these wheat farmers, the year 1969/70 was at least the second year that they had had experience growing this cereal crop.\*

Of the 311 farmers known to have cultivated wheat in 1969/70 for Unit 2, 305 cases yielded suitable data during the field work for the assessment of net crop returns. The distribution by tenure groups is 148 ejidal farmers, 99 private farmers and 58 colonos. The aim of the collection of these data was to estimate as closely as possible the gross and net returns of the individual farmer's crops. Records studied were of the areas cultivated (hectares harvested), the price received (pesos per kilo-ton), the yield obtained (kilo-tons per hectare), and the costs of growing the crop (cost in pesos per hectare). In addition to the calculations of gross farm revenue, interest lay in the possibility of identifying significant correlations between certain variables. e.g. between yield and the incidence of double cropping.

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\*Complete data regarding previous sowing practices were available for only 234 of the 305 farmers in the sample.

MAP 3

FARM AREAS SAMPLED IN  
UNIT 2, FUERTE DISTRICT  
SINALOYA

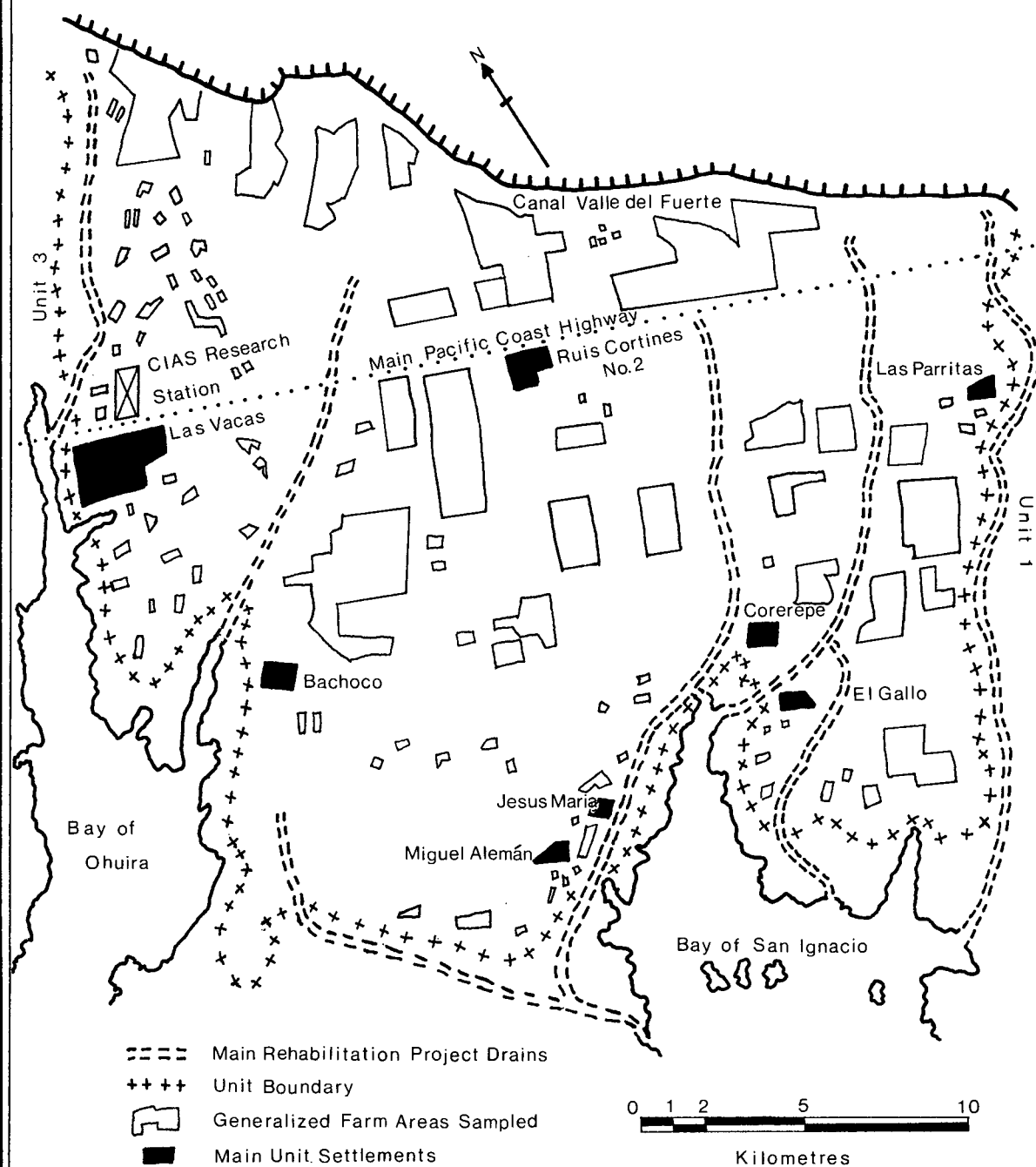


Table XXXI Tests for Normality of Unit 2 Farm Sample Data Based on Skewness &amp; Kurtosis

	Number of points	Mean	Variance	Standard Deviation	Coefficient of Variability	Skewness	Kurtosis
<u>Area Private</u> (P)	99	61.414	945.372	30.747	0.5007	0.02217	1.70824**
<u>(has) Ejidal</u> (E)	148	9.682	1.176	1.085	0.1120	-4.30305**	24.61182**
<u>Colono</u> (C)	58	10.104	3.403	1.845	0.1826	2.25408**	17.42158**
<u>Yield</u> (P)	99	3.3874	0.332	0.576	0.1700	-0.8591**	3.50036**
<u>(kilo-tons</u> (E)	148	2.8662	0.586	0.765	0.2669	-0.78772*	3.40686
<u>per ha.)</u> (C)	58	3.2681	0.148	0.384	0.1176	-0.50293*	3.74033**
<u>Double</u> (P)	99	1.1313	0.4575	0.6764	0.5979	-0.16539	2.16902
<u>Cropping</u> (E)	148	1.0811	0.3448	0.5872	0.5431	-0.01639	2.85002
<u>(incidence)</u> (C)	58	1.1897	0.3261	0.5711	0.4800	-0.01454**	2.75012
<u>Gross</u> (P)	99	2703.821	213325.0	461.8711	0.1708	-0.84203**	3.44079
<u>Returns per</u> (E)	148	2260.380	400212.0	632.6230	0.2799	-0.60803**	3.17497
<u>ha. (pesos)</u> (C)	58	2611.371	96407.0	310.4946	0.1189	-0.49179	3.67159**
<u>Gross</u> (P)	99	169969.1	9122271000.0	95510.556	0.5619	0.21303**	1.80834**
<u>Returns per</u> (E)	148	21837.84	42673920.0	6532.53	0.2991	-0.58847**	2.89495**
<u>farm (pesos)</u> (C)	58	226358995	25367040.0	5036.566	0.1911	-0.47549**	5.90007**
<u>Net</u> (P)	99	154.087	213288.3	461.83133	2.9972	-0.84126**	3.42919
<u>Returns per</u> (E)	148	-289.345	400173.4	632.5925	-2.1863	-0.60803**	3.17437
<u>farm (pesos)</u> (C)	58	61.629	96373.9	310.4414	5.0373	-0.48810	3.61079
<u>Net</u> (P)	99	13378.60	913965800.0	30231.87	2.2597	0.24669**	3.17381
<u>Returns per</u> (E)	148	-2849.606	38964780.0	66242.176	-2.1905	-0.68061**	3.28416*
<u>farm (pesos)</u> (C)	58	597.697	110477200.0	3236.85	5.4155	-0.69778*	3.99258*

\*\* Significant at the 1% level.

\* Significant at the 5% level.

Source:- Computed from Field Sample Data, August 1970.

The data were initially tested for normality to facilitate the subsequent analysis. The results are presented in Table XXXI. As can be seen from the skewness and kurtosis\* column entries, the only set of data that can be regarded as normal for the purposes of further statistical testing is that for the incidence of double cropping where both the ejidal and colono skewness and kurtosis entries are not significantly different from the expected values for a normal distribution. In all other cases no pair of entries for two or more tenure groups within a data category has results that are not significantly different from the expected values in a normal distribution.\*\*

Having established the nature of the data collected from the 305 farms in Unit 2, tests were run to establish the significance of the differences between the means of the three tenure groups for the seven data sets listed in Table XXXI\*\*\*. The results of these tests are shown in Table XXXII<sub>i-vii</sub>. In Table XXXII<sub>i</sub>, the results shown are confirmation of what could have been adduced from inspection. e.g. the highly significant difference between the mean sizes of the private farms and the ejidal and colono holdings, and the not significant differences between the mean sizes of the ejidal and colono farms. Regarding yields in Table XXXII<sub>ii</sub>, there are significant differences between the private and ejidal, and the colono and ejidal, but not between the private and the colono. No significance in the differences of means between the three groups was found with respect to the incidence of double cropping (see Table XXXII<sub>iii</sub>). It is instructive to note that the results shown in Tables XXXII<sub>i</sub> and XXXII<sub>ii</sub> for this sample are replications of what was found at the broader Unit and District level, but that the evidence in relation to double cropping of wheat only in the

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\*Kurtosis can be thought of as a measurement of the "peakedness" of the distribution of data points. Skewness is a measurement of the displacement of the mean from the peak - zero value=a perfect curve.  
 \*\*See Appendix 2 for details of the use of skewness and kurtosis as a test for normality in data.

\*\*\*See Appendix 3 for details of the tests used for measuring the significance of the differences of the means.

Table XXXI Significance of the Differences between Means of  
Unit 2 Wheat Sample Farms, 1969/70

		Number of Points	Mean	Standard Deviation	Test Statistic
<u>i</u>	<u>Size of Farms</u> (hectares)				
	Private	99	61.414	30.7469	16.7337**
	Ejidal	148	9.682	1.0845	16.7337**
	Private	99	61.414	30.7469	16.5536**
	Colono	58	10.104	1.8448	
	Colono	58	10.104	1.8448	1.6311
	Ejidal	148	9.682	1.0845	
<u>ii</u>	<u>Crop Yield</u> (Kilo-tons per hectare)				
	Private	99	3.3874	0.5759	6.0970**
	Ejidal	148	2.8662	0.7652	
	Private	99	3.3874	0.5759	1.5531
	Colono	58	3.2681	0.3843	
	Colono	58	3.2681	0.3843	4.9842**
	Ejidal	148	2.8662	0.7652	
<u>iii</u>	<u>Double Cropping</u> (Incidence)				
	Private	99	1.1313	0.6764	0.6025
	Ejidal	148	1.0811	0.5872	
	Private	99	1.1313	0.6764	0.5764
	Colono	58	1.1897	0.5711	
	Colono	58	1.1897	0.5711	1.2175
	Ejidal	148	1.0811	0.5872	
<u>iv</u>	<u>Gross Returns per hectare</u> (pesos)				
	Private	99	2703.82	461.8711	6.3616**
	Ejidal	148	2260.38	632.6230	
	Private	99	2703.82	461.8711	1.4946
	Colono	58	2611.37	310.4946	
	Colono	58	2611.37	310.4946	5.3118**
	Ejidal	148	2260.38	632.6230	
<u>v</u>	<u>Gross Returns per Farm</u> (pesos)				
	Private	99	169964.1	95510.56	15.4076**
	Ejidal	148	21837.84	6532.53	
	Private	99	169961.1	95510.56	14.9253**
	Colono	58	26358.95	5036.57	
	Colono	58	26358.95	5036.57	5.3072**
	Ejidal	148	21837.84	6532.53	

\*\* Significant at the 1% level.

Source:- Computed from Field Sample Data, August 1970.

sample is divergent from the picture given previously in Chapter 111 on a broader scale of examination.

Given the existence of significant yield differences as indicated in Table XXX11<sub>ii</sub>, the results shown in Tables XXX11<sub>iv</sub> and XXX11<sub>vi</sub> are not entirely surprising, showing there to be no significant differences for the mean gross and mean net returns per hectare between the private and colono groups, whilst significant differences exist between the private and ejidal and the colono and ejidal groups. The position is somewhat changed on the basis of returns per farm. There are significant differences for gross and net returns per farm between all the groups (see Tables XXX11<sub>v</sub> and XXX11<sub>vii</sub>). The effect of the private sector's much larger mean farm size is apparent in the higher mean returns in both gross and net returns, while there is a less marked margin of difference in gross returns between the farms of more similar size of the colono and ejidal groups, though the difference is nonetheless statistically significant. After cost of production has been taken into account, the gap between the colono and ejidal groups widens considerably (see Table XXX11<sub>vii</sub>), with the ejidal group registering a much inferior level of return.

From the data used in Tables XXX11<sub>v</sub> and XXX11<sub>vii</sub>, Table XXX111 and Figures 4a-d\* and 5a-d\* were constructed. Both Table XXX111 and the two groups of Figures give measurements of the evenness or equality in the distribution of farm returns for the individual farming groups and then for all groups together within the Unit 2 wheat sample. As would be expected from the very considerable spread in size of private farms in the sample, this group has the least equality of returns among its members, or the lowest index of evenness, whilst the ejidal and colono farms have much higher indices of evenness. It should be noted that the equality in the distribution of income for all farms considered together is much

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\*The Lorenz Curves, or cumulative frequency curves, can be interpreted simply in the following manner. The diagonal line represents perfect equality in the distribution of returns while the plotted line shows the actual distribution for the farms studied. Clearly the further the plotted line is removed from the diagonal the greater is the level of inequality in the returns distribution within the farms.

Table XXXII Significance of the Differences between Means of  
Unit 2 Wheat Sample Farms, 1969/70 -- Continued

		Number of Points	Mean	Standard Deviation	Test Statistic
<u>vi</u>	<u>Net Returns per hectare (pesos)</u>				
	Private	99	154.087	461.8313	6.3619**
	Ejidal	148	-289.345	632.5925	
	Private	99	154.087	461.8313	1.4967
	Colono	58	61.629	310.4414	
	Colono	58	61.629	310.4414	5.3120**
	Ejidal	148	-289.345	632.5925	
<u>vii</u>	<u>Net Returns per Farm (pesos)</u>				
	Private	99	13378.60	30231.87	5.2664**
	Ejidal	148	-2849.61	6242.18	
	Private	99	13378.60	30231.87	4.1659**
	Colono	58	597.69	3236.85	
	Colono	58	597.69	3236.85	5.1740**
	Ejidal	148	-2849.61	6242.18	

\*\* Significant at the 1% level.

Table XXXIII Indexes of Evenness for Gross & Net Income of the  
Unit 2 Wheat Sample Farms, 1969/70  
(percent)

	Gross Returns per Farm	No. of points	Net Returns per Farm
Private	67.7818%	99	75.3029%
Ejidal	83.3419%	148	80.2575%
Colono	90.4790%	558	83.1776%
All Farms	43.9389%	305	84.4313%

Table XXXIV Correlations between Area & Yield (Private Farms only),  
& between Double Cropping & Yield (All Farms), of the  
Unit 2 Wheat Sample Farms, 1969/70  
(Dependent variable = Yield)

	Variable	No. of points	Correlation	Probability
Private	Area	99	0.2621	0.0086**
Private	Double Cropping	99	-0.1365	0.2627*
Ejidal	Double Cropping	148	-0.0381	0.6869*
Colono	Double Cropping	58	-0.4425	0.0034**

\*\* Where probability  $\leq .005$ , correlation is significant.

\* Where probability  $> .025$ , correlation is not significant.

Source:- Tables XXXII, XXXIII, XXXIV Computed from Field Data, Aug. '70.



higher after cost than before it. This is particularly well illustrated in Figures 4d and 5d, giving the Lorenz Curves for all farms, for gross and net returns.

An attempt was then made to ascertain whether there were any statistical correlations between the principal variables for which data were available and reliable. The results of the correlation test run are shown in Table XXXIV. For the private group there is a significant correlation between the area of the wheat farm and the yield obtained, while there is no significant correlation between the yield obtained and the incidence of double cropping practices on those holdings. Since the area of the ejidal and colono farms examined was so uniform throughout, unlike the private sector, there was in these cases, no point in testing for significance between area and yield. It was possible, though, to test for the effect of double cropping on yields in these two cases. In the ejidos, it was found that no significant correlation existed, as in the case of the private sector, but the opposite held for the colono sector. i.e. as the incidence of double cropping changes so do the yields obtained on the colono farms.

The material used in the computation of Tables XXXI<sub>i-vii</sub> was re-ordered so that it was grouped on a settlement and/or section location basis (see Table XXXV). This was done to facilitate reference back to earlier remarks made on the development of the Unit 2's ejidos and the regional origins of their farmer populations. As can be seen in the average net returns per hectare column, the ejidos of Ruis Cortines No.2, Bachoco and part of the Las Vacas sample have the highest average net returns per hectare. Referring back to Table XXIX of this chapter it is also seen that the above mentioned ejidos are those that have significant proportions of in-migrants within their farmer makeup. It was found in the detailed field work carried out that not only did the sample members of these ejidos have the highest ejidal yields, and consequently the best net returns, but these individuals also did

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Table XXXV Analysis of Wheat Production on Unit 2 Sample Farms, 1969/70

Type/ Location	Section NNumber	Number of Samples	Av. Plot Size (ha)	Av. Yield (kt/ha)	Av. Price (ps/ha)	Av. Gross Returns(ps)	Av. Net Returns(ps)	Av. Net Return per ha(ps)
Private	15	11	66	2,825	800	149,160	-19,120	-289
Las Parrítas	15	11	10	2,009	800	16,072	- 9,425	-942
Private	16	13	71	3,689	800	209,535	+28,506	+401
Private	17	6	56	3,758	800	168,358	+25,574	+456
El Gallo	17	2	4.5	3,000	800	10,800	- 673	- 67
Colono	17	19	10	3,278	800	26,224	+ 737	+ 73
Private	18	12	92	3,450	800	253,920	+19,347	+210
Private	19	13	70	3,789	800	212,184	+33,705	+481
Ruis Cortines No.2	19	6	10	3,500	800	28,000	+ 2,502	+250
Colono	19	5	10	3,250	800	26,000	+ 503	+ 50
Colono	20	7	10	3,200	800	25,600	+ 103	+ 10
Private	21	9	69	3,400	800	187,680	+11,750	+170
Colono	21	12	10	3,565	800	28,520	+ 3,023	+302
Private	22	6	67	2,817	800	150,991	-19,838	-296
Jesus Maria	22	6	10	2,500	800	20,000	- 5,498	-549
Corerepe	22	3	10	3,100	800	24,800	- 698	- 69
Colono	22	2	13	2,940	800	23,520	- 1,977	-197
Private	23	6	45	3,250	800	117,000	+ 2,263	+ 50
Colono	23	1	10	3,200	800	25,600	+ 103	+ 10
Private	24	5	55	3,500	800	154,000	+13,766	+250
Miguel Alemán	24	5	10	3,125	800	24,100	- 1,397	-139
Las Vacas	24	1	10	3,000	800	24,000	- 1,497	-149
Colono	24	9	10	3,180	800	25,440	- 57	- 5

Table XXXV -- Continued

Type/ Location	Section NNumber	Number of Plots Sampled	Av. Farm Size(ha)	Av. Yield (kt/ha)	Av. Price (ps/ha)	Av. Gross Returns(ps)	Av. Net Returns(ps)	Av. Net Return per ha(ps)
Private	25	7	58	3.857	800	178,964	+31,082	+536
Las Vacas	25	3	10	3.000	825	24,750	- 747	- 74
Bachoco	25	8	10	3.500	800	228,000	+ 2,503	+250
Colono	25	2	10	3.250	800	26,000	+ 503	+ 50
Las Vacas	26	10	10	3.500	800	28,000	+ 2,503	+250
Bachoco	26	2	10	4.000	800	32,000	+ 6,503	+650
Las Vacas	27	12	10	3.516	840	29,534	+ 4,037	+403
Private	28	3	48	3.333	800	127,987	+ 5,601	+116
Las Vacas	28	7	10	2.300	740	17,020	- 8,477	-847
Colono	28	1	15	3.000	800	24,000	- 1,497	-149
Las Vacas	29	44	10	2.620	800	20,960	- 4,537	-453
Private	30	8	62	2.800	800	138,880	-19,201	-309
Las Vacas	30	30	10	2.896	740	21,430	- 4,067	-406

Source:- Computed from Field Sample Data, August 1970.

machine work and other outside remunerative work on either private holdings or on ejidal land where bank services were not being operated.

These successful ejidatarios, prior to operating land in their present locations, had all farmed before, south in the central highland states, in the nearby municipio of Ahome, or in Sonora/Chihuahua. They all came to this Unit of the Fuerte scheme to improve their standard of well-being and that of their families, yet all these farmers had nonetheless sustained financial losses in their first year of farming on the valley flats. Naturally all ejidatarios from near and far, had come to the Fuerte to improve their standard of well-being, but the difference between them and the successful immigrants is that those that have left homes outside the State and have left old farms have everything to lose or gain when they arrive in a new agricultural environment of closely controlled water supply and the use of modern inputs. Moreover, the in-migrant has no idea of what alternatives there are, if any, to agriculture should he have to leave that occupation, while the longer established native and better familiarized State citizen is much more aware of the possibility of non-agrarian work. Given that the in-migrants in the main are more determined to succeed than the other groups, it is not too surprising to find that it is the newcomers to Sinaloa that are most aggressive in their adoption of crop pesticides and other yield-improving techniques. All had applied for and received bank credit in their initial years, since no other source existed for them. Without exception, the members of this successful groups were of the opinion that the nature of the facilities given in the bank credit system was financially detrimental to the income level of an incoming farmer with only average skills and two to four years of crop cultivation experience. They did state, however, that elements of the credit system were most instructive either to an agricultural novice (one-time squatter) or to an in-migrant to the area with no experience in commercial crop culture on irrigated land. It is not the intention of this author, nor within the scope of this study, to

determine motivations or wills to succeed in the ejidal farmers nor is it intended to attempt some argument to explain why exactly the noted differences in yields occurred between the immigrants and the other ejidatarios. More important is the fact that 65.5 per cent of the ejidal group make losses while only 44.8 per cent and 33 per cent of the colono and private group respectively make income losses. The ejidal position is obviously aggravated by its worse yield but it must be asked whether or not this record of negative returns is entirely the effect of the inferior yields? It is suggested that the ejidatarios do not have as complete control over their costs of operation as the other two tenure groups and that, due to that factor, the magnitude of the ejidal losses is unnecessarily great. With the sample data at hand and the information gathered from farm interviews it is appropriate that the main hypothesis of this paper be considered at some length for the purposes of its verification. That hypothesis, as stated earlier in the Introduction, is that the ejidatarios in a modern agricultural area of Mexico, here the Fuerte, do not have the opportunity to operate their farms as effectively or remuneratively as they might or would like, because they have to work within the constraints of the Agrarian Laws. To this end, it is essential to examine the most important factors in all farming apart from farmer, climate and productiveness of land:- the supply of agricultural credit, its source(s) and the conditions under which it is granted and operated.

#### Mexican Agrarian Credit

Without irrigation the farmer cannot operate. Without seed, fertilizer, pesticides, labour and/or machinery, the farmer cannot operate. Without extension services and marketing facilities the farmer cannot maximize returns for his efforts. Without previous agricultural experience, or an education in agrarian techniques, the farmer will not initially succeed. All the aforementioned inputs and operational requirements are available in varying proportions in the Fuerte Valley, but the crucial item is credit. Without credit, the farmer is unable to purchase his physical inputs.

Without his physical inputs, the farmer cannot cultivate or hope to produce.

The question of agrarian credit and its supply is all important in modern agriculture and nowhere is the need for working capital greater in Mexican agriculture than in the Northwest, where the monetary cost of farming is high. Irrespective of tenure membership, the farmer requires tangible financial credit. As Haissman (1970, 177) neatly puts it:

"<sup>11A</sup> Agricultural credit is the fuel which activates the farm agricultural activities. No farmer using modern technology can operate without agricultural credit. The necessary inputs - seeds, fertilizers, insecticides, machinery, labour - ..... Hence an efficient agricultural credit system, which assures sufficient credit to the farmer at the necessary times, and achieves a full recuperation of the loans so that they can be reinvested, is as important for the agricultural process as the irrigation system itself."

The farmer cannot pay for his inputs in kind with beans or grain, and the southern farmer from the State of Oaxaca, unused to making hard currency payments for seed or implements, must quickly adopt the agrarian prerequisite here - the use and understanding of money; a small peasant operator from the not distant State of Nayarit, for example, quickly comes to realize that he cannot take his water from the canal or lateral and not be expected to pay for it. Obviously, with the implementation of water-flow regulation and the construction of water distribution nets, the users - the farmers - must be charged for the water they subsequently need and receive.

The non-availability of free water to any cultivator is a sizeable financial burden for the peasant, especially for newcomers from the southern and central upland States of Mexico, where water is frequently gathered in ponds and stored temporarily for field use by the individual. The cost to him then was his own time and labour. It was all part of this life and agricultural cycle, just as was the bargaining over his purchase of seed, "paid" for by his surplus beans and some savings from the previous month's tomato crop. When

the peasant farmers migrated in thousands, starting in the late 1940s, for this area, they encountered a system of agricultural finance quite foreign to them. Only after some period of adjustment, which usually could not be longer than 4-5 years, the peasant cultivator had to become reasonably au fait with the credit system. Without interaction with that system, the campesino cultivator either left the operation of his plots to someone else, a younger member of the family with more educational experience and expertise, or the plot was rented out on a yearly basis most frequently to a private agriculturalist. With a guaranteed income of possibly 8,000 pesos per annum (10 hectares at 800 pesos per hectare) in rent, the campesino could afford his family shoes, a transistor radio, a clock, a set of good quality cooking utensils, and they could probably eat meat once a week. With luck, he could find a job in a Los Mochis service outlet, work in a cotton gin, or, better still, be trained as a tractor driver and work for a private farmer. His wife could likely gain part-time employment in a tomato-packing plant, and the household could certainly afford a motorized cycle after 1-2 years of renting and thrift. The peasant's gross family income for the year might approach 11,000-12,000 pesos, an income affording a standard of living quite unheard of in his native area of Tepic (Nayarit).

The golden dream of the Northwest had materialized, and the peasant with his 10 hectares of irrigation District land enjoyed the prospect of a regular minimum yearly income which he could considerably augment. Drinking water and electricity were available to him at low cost, while the city services were within his grasp, soon to become normal needs in his "want-pattern".

Theoretically, the beneficiaries in the illustration above are simply the peasant and his family, the operator of his land, the city retail outlets, probably the irrigation District via a higher growth rate, and the investors in the scheme via secure loan repayments. The losers are the Ejidal Credit Banks in higher operation costs per farmer through a drop-off in estimated clients, the ejidatarios who work their land, and of course, the Revolution!

Taken to an extreme stage of development, land becomes re-concentrated, illegally, in the hands of a smaller and smaller number of big operators, the average worked size of private holdings approaches 800-1,000 hectares instead of the legal 100 hectare maximum, 60-70 per cent of the ejidal land is rented out, and the economic gains to farming are distributed even more unevenly, being channelled to the large, private holders. The peasant, by renting out his land, becomes less independent by accepting and coming to rely on outside employment, provided by the large farmer and his associates.

Outside such minor service employment, the ejidatarios' choice is in the industrial sector. Industry in the region is in its infancy, amounting in 1965 to only 3 per cent of the total industrial production in Mexico and only 13 per cent of the employment in the Northwest; existing industry is almost totally based on agriculture - cotton gins, sugar refineries, vegetable canneries - and these areas of sectoral growth are largely controlled directly or indirectly by a small number of "landed" entrepreneurs or outside companies.

Not only does such a campesino thus lose his independence, but, though he may gain a much higher standard of well-being, his farm, illegally rented out, may be confiscated by the government and he may not obtain the chance of land title again. Haissman (1970, 101 & 110) tells us that between 30 and 50 per cent of the Fuerte ejidal land is rented out, either to private farmers or to other ejidatarios.

#### Sources of Tenure Groups' Credit, Application Procedures and Characteristics of Services Supplied

Large scale irrigation agriculture in the Northwest, and on the Fuerte, commenced in the late 1950s, within a newly established agro-credit system. The principal credit institutions are the Ejido Bank (Banco Nacional de Crédito Ejidal), the Agricultural Bank (Banco Nacional de Crédito Agrícola), which took over the agrarian activities of the Foreign Commerce Bank in 1963 (Banco Nacional de Comercio Exterior), and the Bank of Mexico. In addition to these outlets for credit, there are the private banks of Credit Sonora-Sinaloa, the First National Bank, the Bank of London and Mexico, and the recent creation of the Banco Agropecuario del Noroeste (for ejidal users). All of the aforementioned have



sizeable branches in Los Mochis, all in modern architectural structures with marble floors and powerful airconditioning. Operationally, however, there are very great differences between the private banking sector and the national (ejidal) agrarian credit sector. The following cases serve to illustrate the two principal types.

In the case of the larger private farmers, with over 50 hectares of land, credit is obtained from Unions. Unions are merely banks organized as a cooperative holding finance company, where credit is awarded only to members of the Union, its shareholders. Since the Union collects no profit over and above its expenses, it is able to extend credit to its members on more advantageous terms than a normal commercial bank, the credit source for the smaller private operators in this tenure class.

The existence of the Union de Crédito Agrícola de Corerepe based in Mochis is not exceptional for the Northwest. According to Haissman (1970), most large private farmers belong to credit Unions in Sonora and Sinaloa. The Union de Corerepe was formed in 1956 at the start of large scale District irrigation, and today its membership hold, on average, 170 hectares.\* Although the immediate task of the Union was then to supply working capital for its members, ever since its inauguration, the Union has pursued an aggressive policy of cutting the farmers' input costs by investing its resources in plant. Between 1956 and 1959, 15 million pesos was spent on a fully automated grain elevator and packing plant. A saving of 80 per cent was made in handling, storage, and bulk packing by this plant compared with the nearby government CONASUPO operation (Compañía Nacional de Subsistencias Populares). Next there followed a fertilizer mixing unit, with an insecticide plant and oil purification installation. The last mentioned item was built 5

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\*During the survey work carried out in June-August 1970, it was unofficially estimated that there were 10-12 extremely large private farms. The largest were of about 3,000 hectares and were located in Unit 2. The extra land acquired for these massive holdings was registered officially under the names of relatives, and employees of the landowners.

years ago when it was found that the maintenance costs of machinery (combines, tractors etc) were unpredictably high. Problems arose in the combustion of the fuel oil supplied by PEMEX (Petroleas Mexicanos), so the Union purified the supplies it received and then sold it to its members. There was a resultant 50 per cent reduction in maintenance costs and at the same time a 50 per cent cost reduction to the members for the purchase of insecticides. Machinery purchase costs, too, are reduced for members because the Union can plan to order larger quantities of equipment at one time from the suppliers.

Interestingly enough, the Union does not cater for agricultural extension services, but it will refer members' problems to the local CIAS station (Agricultural Research Centre for Sinaloa) or to CIANO (Agricultural Research Centre for the Northwest) outside Ciudad Obregón in Sonora.

The Union's most recent development is in supplying seed. By encouraging its own members to develop local hybrid varieties, it is possible for the Union to sell its members' produce and skill to other farmers of the area. At present one of the Union's wealthiest and most skilled members is developing a hybrid long-grain rice seed for the world market, which will be marketed this year (1971). Its yield is forecast at 8 kilo-tons per hectare, which is almost double the maximum obtainable anywhere at present.

No credit facilities equivalent to the private Unions exist for the ejidatarios. This is not surprising since the ejidal members can be said to possess little or, in most cases, no capital. As stated earlier, the ejidatario does not have full title to his land and has no other property which can be used to guarantee a loan. Private banks will not extend credit to him. However, no farmer can operate without credit, since the value of the necessary crop inputs exceeds by several times the value of the annual net profit, and no farmer has such amounts of liquid capital (Haissman 1970, 108). Thus the ejidatario is limited to

government banks, the Banco Ejidal and the Banco Agropecuario. The details of loan application, acquisition, and operation are given below for a typical ejidal case. The following is the experience within the Fuerte District of any ejidatario with little or no experience of the area or farming, or of one with several years' experience. As will soon be appreciated the viability of both the bank and the applicant are considerably limited by the necessary rigidity of the system, basically a function of the tenure system.

When the ejidatario decides what crop or crops he wants to cultivate in the year (October- September) he contacts his bank representatives in the nearest village locality or in Mochis. The bank then reviews, with the applicant, the cultivation proposal in the light of expected water availability for the coming season as calculated by CRF, the demands made to date, the market supply-demand characteristics, the likely rural price and the local soil conditions of the applicant's area. At this stage the bank either rejects the ejidatario's crop(s) proposal, for example on the basis of probable local overproduction, and then formulates an alternative crop cultivation schedule, or it gives the go-ahead to the applicant's original ideas. In either case, a detailed loan schedule is retained by the ejidatario, primarily to be used as a cultivation calendar, while the bank, of course, retains copies for its financial and operational-check records...

The loan is normally of a year's duration, and only in quite exceptional cases is it given for any period in excess of one year. Calculations are made of the costs of land preparation, seeds, fertilizer, pesticides, irrigation water, harvest labour and machinery, output packing and transportation, although only in the case of very badly located and extremely poor farmers do transport costs loom significant. Ninety per cent of the campesinos easily manage to transport their produce themselves, or with the aid of neighbours, to the nearby mills, gins, elevators and warehouses. Thus virtually every stage within the cycle is costed. Quite

simply, the total of the parts equals the sum of the farmer's loan. The calculations are pretty accurately assessed. One reason for this is the fact that government banks operate with relatively slim resources, and to fulfil their role of service within their charter, tight monetary item-costing is imperative. To prevent the ejidatario from squandering his loan, the bank does not hand over hard currency at the initiation of the production cycle. The applicant receives currency only immediately before he requires it for any stage in his cultivation process. Thus the farmer receives money to purchase seed from an appointed dealer only a day before he is due to make his purchase. To further safeguard the loan's efficiency, the bank employs a large number of operations- and field-inspectors, who check on the use of the loan in the production cycle. Where operations of land levelling and ploughing are involved, the bank supplies both the labour and machinery for the job, and the ejidatario handles no money for those services, since the bank invariably owns the machinery to be used and contracts labour to operate it.

It should be pointed out that in addition to the cultivation calendar set up by the bank for the applicant to follow, on the basis that adherence to the time schedule will best guarantee good yields, the bank also instructs the applicant in the techniques of crop sowing, weeding and harvesting. Obviously an inexperienced loan applicant or newcomer to the Fuerte District must at all times follow the instructions he is given. The importance of this service has, at last, been recognized by the State (Sinaloa) and Federal agencies, primarily because the banks are unable through lack of sufficient funds and extension manpower, to serve the campesino population completely and effectively enough.

One non-bank service open to the ejidatario is that of crop insurance. In practice, it is imperative for the campesino to use this facility. On the one hand, crop insurance is not possible unless the party to be insured uses certified seed, while on the other, bank credit is not forthcoming to the loan applicant unless the campesino uses certified seed. In the case of wheat,

fire insurance is also a wise policy, where there is a very high danger of crop loss when rapid drying occurs during final ripening just prior to harvesting.

Where an insurance claim is made by a campesino, the insurance company on verification of the claim, does not pay the policy holder directly but goes indirectly through his bank. So in actual fact, the credit system safeguards itself by merely deducting the value of the insurance claim payment from the loan balance outstanding at that date. Within the insurance structure too, there is a catch, as far as the insured is concerned. In the event of crop damage due to climatic hazards such as flooding or wind, the amount payable by the insurance company is equivalent only to that value of the production process operated up to the time of the claim. The claim is based therefore on the costs incurred up to that date on the bank's production schedule.

#### Operational Influences of Credit on Farming

From the previous exposé obvious advantages emerge for the private farming group over the ejidal sector. The basic shareholder structure of the credit Union of Corerepe has clear merits where the shareholders are both immediately concerned in the efficiency of their holding company from the viewpoint of an investor, and at the same time are concerned with receiving good liquid credit assistance whenever necessary. It is implicit in their system, of course, that the Union members are highly competent farmers who automatically seek out techniques whereby they can maximize their profit at all times.

The campesinos on the other hand cannot envisage being members of such a Union since they have nothing tangible to invest as potential shareholders. This major difference in the two groups' command of resources should never be overlooked; one group has considerable financial liquidity and/or tangible securities, while the other has neither. The campesino, educated or not, practised or novice, deals with a large government organized agency which at the same time has to enforce on itself and its customers tight

restraints on operational behaviour in order to secure loan repayment. The private farmer and Union member applies for whatever credit or aid he requires for his production cycle whenever he requires it. He applies only for what he needs and receives only that. The ejidatario applies for production assistance, and in 90 per cent of the cases where his application is favourably entertained, he receives assistance for the operation of the whole agricultural cycle, irrespective of his actual needs.

For example, the campesino invariably will receive, and be charged for, land preparation services and labour for weeding during his production year. Except where the use of a land leveller is required, which is only an infrequent occurrence, assuming the land has been recently worked before, the campesino with his family could quite adequately prepare and maintain his 10 hectare farm. When he required machinery he could hire the local tractor operator's equipment, where he, the campesino, is adept, or he might hire the complete package of tractor and operator where he is not. In such a case, if the hired workman's results are not to the peasant's liking, he could withhold payment until the problem is remedied. But in the case of work done by the contracted-out labour supplied by the bank, the peasant automatically pays for the service received, irrespective of his satisfaction with the job done. In fact, the machinery contractor or collective machine centre (bank affiliated) come to give their services at times most convenient for themselves, not when it is most desirable for the recipient's crop. While the use of machinery contractors is quite prevalent, it has the further disadvantage of transferring to the contractor the profits which should have gone to the ejidatario if he could operate his own machinery. Thus, if, as is frequently the case, the work done is unsatisfactory to the campesino, he has no recall on the labour, which, by the time a complaint is lodged, has moved on to another assignment. The contracted operator is paid on the basis of land area attended to. Hence less care is taken over the individual plots than would be, were the farmer to do it himself, since the bank automatically makes payment for the contracted labour.

The campesino then, theoretically, has one of two alternatives open to him. The first is to notify the bank which inspects his claim for verification purposes. The bank then arranges for another implement operator to re-do the work for the campesino. The speed with which this action is taken varies directly with machine- and operator-availability. If the time of complaint is in the midst of sowing or harvesting, where the predominant ejidal crops are cotton, sugar cane, or rice, then the peasant is unlikely to have his problem remedied within 10-14 days. At the other extreme when conditions are more favourable, he may have to wait only 4-5 days. Either way, however, if the snag arises at a crucial time when harvest is essential, or before a due irrigation, then even 4-5 days' delay is quite impossible if yield failure is to be completely avoided.

Alternatively, he can register a complaint to the bank but gain the services of an independent machine or labour agent. In such a case, the ejidatario, in an emergency, can virtually count on his obtaining remedial services within 2 days and having the work performed to his satisfaction by a local individual. Frequently, that individual is an ejidatario himself, who owns machinery necessary to work land he owns or has rented to him, over and above his original 10 hectare plot. A tractor can till 60-100 hectares, hence an ejidatario must do outside machine work if he is not to incur excessively high operational charges for the privilege of tractor ownership. To minimise high overhead costs, the machinery owner hires himself and his equipment out, and does extra work at any time when it is possible for him to do so. The recipient of the work rarely pays in kind. Instead he normally pays within a month with whatever liquid capital he has at hand. More often than not, the supply of this is small and is dependent on the saving habits of the campesino. If he is one of a breed of quickly growing savings-bank users, then he probably has little problem. If he drinks most of his surplus resources, then he must go to work at the weekends in the town (Los Mochis or Guasave) as a

temporary retail service employee. Obviously the scope for this is limited, and, as a result, so are his chances of quickly paying for the agricultural work done on his land. It is rare, however, to find a campesino who drinks his surplus income and at the same time notices that the work done on his land by the bank was of a poor standard.

It should be clear that in the case of the conscientious peasants, estimated at 60 per cent of the total population, who work their land and receive credit, where problems concerning the quality of work arise, they need to turn not to the bank, but to the independent agent. The latter's services would always be used in preference to the former's since, naturally, the peasant prefers freedom of choice, but the difficulty is that the campesino cannot normally have part-credit from the bank without having it all. He receives labour and machinery services whether or not he absolutely requires them, and irrespective of whether he could make a more efficient arrangement on his own. Furthermore, in the event of the ejidatario's being successful over a period of years and accumulating a sizeable financial surplus, the actions of the bank do not encourage the campesino to make any useful capital investment in his farm or its operations.

#### The Effect of the Credit Programme on the Ejidatarios' Viability

The following situation was found to arise for the ejidatario receiving Ejidal Bank credit in the Unit 2 wheat sample. The nature of the credit programme completely ignored the campesinos' one big asset or advantage over their farming competitors in the area, the private and colono sectors. i.e. the ejidatarios' own labour and that of their families have virtually zero opportunity cost. The use of machinery on a easily manageable 10 hectare plot as substitute for work able to be done by the ejidatario is at one and the same time very extravagant and an unnecessary luxury that the campesino can ill afford. Yet, as stated previously, machinery and outside labour to operate it are part and parcel of



the credit package received by the campesino.

The cost of production of 1 hectare of wheat was assessed at 2,549.7 pesos and was determined in the following manner. Records were obtained from four of the largest credit outlets in Los Mochis, two private and two ejidal. These four institutions supplied extremely detailed cost accounting for the production stages of the whole cycle of wheat production on the average-sized farm holding that they customarily dealt with. With those data at hand as a guideline, information was then collected in the field regarding the main items that could be readily quantified monetarily and which made up the cost of operation. The data gathered from all three tenure groups were then concentrated and summarized. The costs obtained varied noticeably in some instances where the farmers did not want to reveal their costs or where the farmer had no written record of input purchase receipts. The only way to check back against the statements of these individuals, who were most often campesinos, would have been to examine their individual bank credit schedules. This information was understandably regarded as highly confidential and was not forthcoming. Nonetheless it was possible to use the data from over 65 per cent of all the tenure group members interviewed, and from this a weighted mean cost of production was established of 2,549.7 pesos per hectare for all farmers. The figure held by the Ejidal Banks was very near this at 2,575 pesos per hectare!

The outcome of the Ejidal Bank's insistence on modern cultivation practices for its customers was found to have a most unfortunate effect. Namely the cost of credit plus interest to the ejidatario of growing wheat was to all intents and purposes the same as the average costs incurred by the other two farming groups in the sample. It could be argued therefore that the campesinos were not permitted to gain a financial production advantage that was really due them. In the final analysis this was directly a function of their tenure status, a product of the Revolution and its Reform

Laws. Moreover, their livelihood as farmers was made more precarious by their poorer yield performance. The outcome of their artificially inflated costs and poorer yields, combined with the price received, gave rise to the poor net returns as indicated earlier in this chapter.

From the data collected for the sample farmers, it was found that an agriculturalist who sold his wheat at 800 pesos per kilo-ton had to obtain a 3.200 kilo-ton yield per hectare in order to avoid incurring a financial loss. At a yield of 3.100, the operators had a negative net income for wheat. If a peasant farmer, or other type for that matter, were to attain a 3.100 yield and receive 800 pesos per ton for his wheat in the central uplands of Mexico, in Querétaro or Leon, it is fair to suggest that he would be a very productive farmer and would certainly receive a positive net return. In such a location the campesino would be unlikely to have the small though significant additional monetary payments for the support of a growing ejidal school system or for the piping of electrical power to his village. These payments are made along with those levied for the special services made available to the ejidal population by CRF and CFE. It should be pointed out, though, that the ejidatarios decided amongst themselves four years ago that they would individually make a contribution towards the extension of the overtaxed rural school system that had originally been set up by the State of Sinaloa. With very rapid population increase there were just not enough teachers to go round so the campesinos voted to hire the additional teachers required, and to pay for their cost within their irrigation cost assessment (see Table XXXVI). Yet it cannot justifiably be argued that the costs of such "welfare" services should not be partly paid for by the recipients, given the fact that Mexico cannot afford to upgrade the rural infrastructure entirely out of the national exchequer. As it is, the cost of the campesino's vital water supply and associated costs amount to only a little over 10 per cent of his per hectare costs of wheat cultivation, a burden that could not be termed in the least excessive.

Table XXXVI Analysis of Farmers' Water Costs and Scheme  
Charges paid to CRF

<u>Private Properties</u>		<u>Ejidos</u>
150 pesos per ha.	Water.	150 pesos per ha.
100 pesos per ha.	Rehabilitation of District.	100 pesos per ha.
	Towards cost of training of	
2 pesos per ha.	Agricultural agents by State.	2 pesos per ha.
	Teachers in schools.	10 pesos per ha.
	Electric power &/or drinking	
	water.	25 pesos per ha.
<u>252</u> pesos per ha.	<u>Total</u>	<u>287</u> pesos per ha.

The same cannot be said for certain arrangements by the lending banks. By dissecting the makeup of the ejidatario's total cost of operation, estimated here at 2,549.7 pesos, it was possible to subtract the sum of 536 pesos, the cost charged for the services of outside labour at sowing, fertilization, ditching, land preparation, depreciation on the machinery used for these tasks, the cost of machinery operation and the administrative charges associated with the provision of these services. No sample of the ejidal farm population investigated, lacked its own farm labour for carrying out the services rendered by the banks' labour force. Furthermore, over 65 per cent of the ejidatarios' own family labour had had experience of tractor driving and other implement work; all that they lacked was the training in equipment maintenance, something which the banks lacked too! If the campesinos could have operated their wheat activities at the new figure of 2,013.7 pesos per hectare instead of 2,549.7 pesos, 102 out of the total sample of 148 would have made a net positive return rather than only 50. Put another way, with a cost reduction of about 20 per cent over the estimated cost obtaining at the time of field work, 100 per cent more of the peasant farmers would be in the black rather than in the red. The cut-off point with regard to making a net positive return under the adjusted cost system, assuming a price of 800 pesos per ton, was found to be 2.600 kilo-tons per hectare. Some 68.9 per cent of the

campesinos attained this level of yield or bettered it. Perhaps the individual to which the new cost structure is of most relevance is the in-migrant to the scheme area. As pointed out earlier, the Fuerte District has served as an attraction point to many campesinos, particularly to those from the minifundia-ridden, overworked areas of the southern-central upland States of Mexico. Quick discouragement sets in on even the most optimistic and experienced farmers new to the region when they have net losses on their crop activities. Their acute and understandable disappointments have been one of the main factors leading to the renting out of ejidal land, and in some cases even its illegal selling, to private operators or to other campesinos who have avoided failure. Clearly, the system at present, its method of operation and the practical costs it brings with it, are not in the best interests of those for whom the service was set up in the first place. The problem of failure and the situation it brings is most critical for the newcomer to the area, the in-migrant. Given the inflexibility of the banks with regard to the individual, it is frequently reported in the local press that a farmer is in debt at the end of his first year on the Fuerte lands, and yet that farmer had been, the year prior to his moving to Sinaloa, a very successful individual in Morelos or Jalisco. The usual explanation given is not poor yield performance but very considerable increase in the costs of operation, especially for machinery in place of the more traditional labour inputs; inputs proven for their productivity, measured in the good yields obtained using large amounts of low opportunity cost family labour - an economic proposition on the normal 10 hectare plot. Thus the effect of the Reform as far as credit is concerned seems to be working against the principles of the Revolution, principles that are still so strongly voiced in all walks of Mexican life.

Another consequence of the credit system's structure is that it makes for severe under-employment on the farm, even of the farmer himself, not to mention the other potentially productive

members of his family. Whilst collecting the sample cost data and the crop performance material, details of the time spent on the farm's activities were measured. The system of subdividing labour-use employed was similar to that used by Rockefeller(1961/62) and also Andrade and Freebairn (1965). It was modified slightly to include the effect of the outside, bank labour on the employment schedule of the sample's campesinos. (see Table XXXVII)

Table XXXVII Family Labour Supply and its Utilization for the Unit 2 Wheat Growing Ejidatarios, 1969/70

(Man Months)					
Type of Labour	Potential Labour	Labour Nominally Devoted to Farm	Actual Labour on Farm	Off-Farm Labour	Un-Employed
<u>Ejidatario</u>	1,776	940	592	350	486
Sons	780	410	80	100	270
Other Family	178	85	18	40	53
Total	<u>2,734</u>	<u>1,435</u>	<u>690</u>	<u>490</u>	<u>809</u>
Summary of actual use of family labour supply:					
Time not productive			Man Months	Per cent	
Idle time nominally spent on the farm			745	27.3	
Not employed			809	29.6	
			( <u>1,554</u> )	( <u>56.9</u> )	
Productive time					
Actually worked on the farm			690	25.2	
Off-farm employment			490	17.9	
			( <u>1,180</u> )	( <u>43.1</u> )	
Total			2,734	100.0	

As can be seen, the ejidal family labour supply is engaged for only 25.2 per cent of its potential work period per annum on the ejidal farm itself, while over half of the year is spent non-productively. The ejidatario himself was found to be productively involved on his farm for only 33.3 per cent of his yearly potential work span. If the time taken by unnecessary bank services

previously mentioned in the cost reduction calculation, were treated as work periods employed by the ejidatario and his family, they would be productively employed on the farm for approximately 67 per cent of their potential time. This figure takes into account the fact that additional labour and machinery would be employed at the harvest period, inputs that the family would have to have whether they originated from the banks or from elsewhere, such as other farmers or local agricultural produce dealers under a production contract arrangement.

It is interesting to note that in this Unit there are movements afoot within groups of ejidatarios to by-pass the official credit institutions just because of the inflexibility of the services they provide and their frequent poor quality. Campesinos who have on previous occasions grown cotton have made contacts via the merchants and the cotton gins with companies that are prepared to finance the cotton farm operations on condition that the produce is sold only to them, the giver of credit. What, in effect, is happening is that the Ejidal Banks are losing customers who might otherwise have used the government-created credit outlets in preference to the independent commercial crop treaters and exporters, often American owned and/or based, as, for instance, Anderson-Clayton, who give the campesinos a much freer hand with respect to the use of the credit. There are dangers, of course, for both sides in this system:- The firms cannot take the ejidal land if the peasant does not produce the crop since his land is national domain and not transferable to a private entity; the campesino runs the risk of being forced to sell his potential harvest to the firm at a price much below what would be the market price some 4-5 months later at harvest time.

Given that such a system of bank by-passing is growing, and both firms and campesinos appear to be benefiting from its operation, it is not too much to suggest that a similar development may start to grow for the individuals cultivating wheat, particularly since the precedent of cotton is being made known by both sides involved.

## Conclusions

What then are the problems that face the ejidatario on the Fuerte? He, the campesino, may produce a yield of 3.100 kilo-tons per hectare of wheat, a performance which can be regarded as highly satisfactory almost any where; yet at that yield level (with a price of 800 pesos per kilo-ton) the sample taken shows that the peasant farmer has immediately got himself into debt over the cultivation of his crop. Certainly, it is possible that at his second cultivation of the year's cycle, the campesino may operate more viably and gain a good return from his soya, sorghum, or particularly, his tomatoes. However, as outlined earlier, he is not altogether free to grow what he wants nor is he free to use the types of inputs he wants, particularly his own and his family's labour. If he needs to offset a loss to wheat he cannot automatically redeem his losses by deciding halfway through his programme to select an especially remunerative crop such as tomatoes, even assuming that there was a market available to take his produce. Yet if he cannot remove his debt in such a manner he may not be allowed to farm the next year. He then may opt out of active farming and become one of the numerous ejidal renter class, currently estimated at 30 per cent of the ejidal farmer population of the District.

By contrast, both the private and colono sectors are free agents in the sense that they are more able to act independently of their creditors. If they, the private or colono farmers, experience a wheat-income loss, then they can take whatever action they decide on, and in any case their refusal of further credit from their banks is much less likely merely because of one unsuccessful year than it is for the ejidal class, the class that possesses few or no realisable securities.

From the findings of this farm study it was found that the ejidatario who uses the principal source of credit, the Ejidal Banks, is faced with major operational constraints to his farming system as a direct result of his contact with the said loan agencies. In other words, the difficulties encountered are a result of the

ineffective operation of the Reform Laws. The unnecessarily high cost of operation that comes with the credit system run by the Federal Government is cloaked under the heading of farm modernization. Modern agricultural technology is being introduced to most of the rural proletariat and they, who engage in active agriculture, benefit from instruction in the new techniques and practices. The cost of this service, however, is inevitably high because the banks require large manpowerrrresources which are in short supply to carry out the service. Ironically, even although the peasants may acquire the ability to use machinery themselves, the machinery that comes in the credit package comes with other labour to operate it. Were the campesino's holding 50 hectares instead of around 10 the situation would be very different. In that case, the need for outside help, at least in the initial years, would exist until the farmer acquired his own equipment to work the land. But there again, the individual would not want the same services year in year out, something which the banks do not seem to have recognized; this oversight is especially critical to a small holder like the average ejidatario who cannot indefinitely bear the burden of surplus services.

With regard to placing the main weight of criticism on the Ejidal Banks, there are nonetheless two sides to the matter. These banks are beset with structural and operational difficulties, not all of their own making, some of which have been shown to filter down to the campesinos. First, there is the problem of the supplyiof resources to the Ejidal Banks by the Federal Government. The supply forthcoming is directly related to the repayment performance of the banks' customers. The ejidatarios in the Mexican Northwest repay 92 per cent of the value of their loans. i.e. the annual default rate is 8 per cent. Previously the repayment rate was much lower, around 50 per cent, when the ejidatarios regarded credit as a direct government subsidy. The banks are required by law not to charge more than 10 per cent interest and hence with a default rate of 8 per cent the bank is left with 2 per cent to



cover its own operating expenses and the interest it itself must pay for capital - an untenable situation. Thus the Ejidal Banks are overtly or covertly subsidized by the government, and the more credit is extended to the ejidatarios the more money the government loses; thus the government is naturally reluctant to increase the operating capital of the Ejido Banks.

Second, the Ejidal Banks' operation costs are high, much higher than the private banks' costs per user. Take the case of the collective machinery centres operated by the Ejidal Banks: The centres suffer from the inherent problem that their management has no incentive to make them operate profitably, since the centres and their equipment belong to an anonymous Ejidal Bank and not to their managers. As a result, all machinery centres in the Northwest have been economic failures, perpetually in the red, and their number is not increasing (Haissman 1970, 108). Moreover, as a direct result of the ejidatarios' peculiar tenure status, a creation of the Revolution's Reform, the banks' costs are high.- If the campesino legally owned his land then the bank would not have to employ so many field inspectors to check up on the peasant's production practices and progress. At harvest time the banks must hire several hundred inspectors to verify that the ejidatario delivers his harvested crops to the official store, instead of selling it to a private dealer and keeping the proceeds to himself; the store, assessing the value of the crop then repays that part of the ejidatario's loan direct to the bank. The sale is usually made direct to CONASUPO which, owing to its higher operating costs, as a Federally assisted agency, can often only offer prices lower than those of private merchants.

Here we have a situation where Federal domain within a massive government-sponsored irrigation project is donated to the peasant who tries to work "his land", but must gain credit from a government bank to work the land, that bank having no means of recouping its loss if the campesino defaults for any reason; it cannot confiscate the campesino's resources because he probably has none, and the

land cannot be seized because it is Federally held. Yet it has been shown that the action of the Agrarian Reform in its creation of the ejidatario's peculiar tenure status made it necessary for a credit outlet to be created just for that tenure group's use. Because of that tenure group's usufructory characteristics, a far-from-normal credit institution was formed, an institution that had to guard itself on the one hand from its defaulting customers and on the other from the reluctant financier of its operations, the Federal Government.

The banks' principal guard against defaulting, it was found from the study undertaken, takes the form of employing detailed operations schedules for each customer. In practice, however, these schedules not only restrict the loan recipient's freedom to select inputs but they also provide him with over-costly unnecessary services that he cannot afford. Clearly the campesinos' viability in modern Mexican agriculture is in jeopardy as a result of the institutions produced by the Agrarian Reform Laws.

CHAPTER VCONCLUSIONS AND SOME SUGGESTIONS FOR AMELIORATION  
OF THE PROBLEM

Through the work carried out, the hypothesis set out in the Introduction was confirmed and verified by the data collected in the field study area in Northern Sinaloa State. From the initial investigation it was confirmed that the ejidal farming sector of one of Mexico's most modern agro-development areas makes less productive use of its land endowments than the private sector. The potential returns thus foregone are not compensated for in higher overall yields or by a combination of favourable yield and price interaction. Consequently, the data examined gave grounds for the belief that gross potential income imbalances exist between the two farming groups, although some of the differences measured are rather slight and variable.

But more important than these findings are the results of the farm sample study that supported the hypothesis and identified the major factors operating against the best farming interests of the ejidal group. That is to say, it was found that the operational aspects of the Agrarian Reform Laws, as manifested in the Ejidal Credit Banks severely reduce the chances, by the individual campesino, of successful operation of viable land. The system of credit used by the banks is both too inflexible and much too costly for the recipient of the loan. In fact, the schedule structure of the loans is enforcing unnecessary inputs of outside labour and machines instead of making use of the farmer's own labour and certain other services he himself could furnish.

The actions of the banks, a product of the Revolution's Constitution, encourage ejidatarios to stop trying to operate the land they had been given by the nation for the specific purpose of farming. Ejidatarios thus take to renting out their land, an

illegal action but one which brings a guaranteed yearly income from the tenant and an action which avoids the incurrence of considerable debt to the bank.

If this process of land renting out continues to increase from its present proportion of around 30 per cent of all ejidal land on the Fuerte scheme lands, the effect of land redistribution will be entirely nullified since the rewards of resource operation will accrue to fewer and fewer of the area's population. The campesinos in turn will become more dependent on rent income and agro-industrial/service employment in the District's towns, both sectors of which are largely controlled by outside companies or by the powerful large private farmers of the region.

Given the situation examined and postulated here, it appears ironic that the Revolution is still talked of with great fervour and almost respect, and yet it is that Mexican "institution" that is putting a stranglehold on the very sector of the rural proletariat that it supposedly set out to help. The climate is right for the new private owners to make themselves as powerful economically as their predecessors, the hacendados, were strong politically. This climate is being encouraged by these same laws that consciously set out to discourage such concentration of wealth.

Remedial action is urgently required. One method of ameliorating the situation is being implemented at the El Carrizo extension of the Fuerte District. There it is intended to model the ejidos on an "agricultural enterprise" basis (see Haissman 1970, 114-121), where the members are shareholders of the capital equipment amongst other items employed on the enterprise. The system of credit is managed through the Ejidal Banks which are drawing up more flexible credit arrangements than those at present typical for the individual ejidatario. It should be noted that Haissman found this new approach to ejidal farming, as distinct from the old communal ejidos, extremely costly in terms of skilled manpower requirements, and that the whole organizational system of the enterprises broke

down whenever the needed manpower levels were not met at all stages. Furthermore, it must be borne in mind that for a decade or more there will be an insufficient supply of the degree-holding specialists required for such ejidos, if the system were to be implemented throughout the developing North and Northwest of the country, although this system is projected now for use in the PLHINO project.

Short of basic institutional (legal) reform of the ejidal tenure position, which would undoubtedly involve a lengthy period of clever political manoeuvring in order to pacify the ardent followers of Mexico's "institutionalized revolution", solutions have to be found that are outwardly, at least, not too contradictory of the ideologies of national land ownership.

Tentatively, it is suggested that the Ejidal Banks, aided by a specially financed Federal programme, organize training schemes in the first year of a loan applicant's operation to instruct the campesino in the use of machinery. The cost of this scheme could be partly offset by an ejidal contribution operated similarly to the school payment at present used (Chapter IV). The payment would, however, be made only by those ejidatarios receiving the training programme. Haissman found, in his study, that trainees can become quite proficient in the use of equipment within a period of approximately three months of non-intensive instruction. My information is that the manpower needed for such instruction is not costly for the bank to hire, nor is there the immediate likelihood of a bottleneck in its supply as there is in the case of agronomists and soil scientists needed for the "agricultural enterprises". In fact, for the Fuerte District there is probably an adequate supply of instructors at present hiring out their services to other individuals. A revised system of machinery management would be essential, too.

Given the existence of underutilized machinery on several 10 hectare ejidal plots, it is conceivable that in the initial period of the training scheme, the first 2-4 years, the supply of=

equipment for hire from farmers would be adequate, and would fulfil the demands made by the scheme-trained ejidatarios. In conjunction with the loan records system kept for each credit recipient, the bank could operate a loan programme more akin to that of the private outlets once the campesino had been through the instruction in equipment use. In other words, the ejidatario after passing through his trainee period would receive bank credit for services only absolutely essential to his work needs and he would not have to pay for outside labour to work his plots. In this way his excessive and unmanageable present costs of operation would be significantly reduced, at least to the level indicated earlier in Chapter IV. Immediate feasibility is an essential factor in any attempt at the solution of the problem, owing to the pressing need for rectification of the ejidal credit structure. The Reform Laws give insufficient thought to the ejidatarios and implicitly expect too much of them. This is especially true in the case of the Northwest where rapid modernization of agriculture is being hindered, or slowed, by lack of adequate comprehension, by all involved, of the place that the Reform has in mechanized, capital-hungry, scientific crop production. Practicality has had to fight ideology with an inferior result considering the potentials that could be realized by more rational action. As Penn (1962) succinctly observes:

"Every serious plan for economic development in Latin America today includes some kind of land reform. No magic formula for Latin America's economic ills is so widely accepted - and none is so little understood."

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## APPENDIX 1

THE MEXICAN CONSTITUTION OF 1917 AND  
ARTICLES 10 & 27

Regarding Mexico's land and resources, the Constitution states:

"The Nation shall have at all times the right to impose on private property such limitations as the public interest may demand as well as the right to regulate natural resources, which are susceptible of appropriation, in order to conserve them and equitably to distribute the public wealth. For this purpose necessary measures shall be taken to divide large landed estates; to develop small landed holdings; to establish new centers of rural population with such lands and waters as may be indispensable to them; to encourage agriculture and to prevent the destruction of natural resources, and to protect property from damage detrimental to society. Settlements, hamlets situated on private property and communes which lack landssordwater or do not possess them in sufficient quantities for their needs shall have the right to be provided with them from the adjoining properties, always having due regard for small landed holdings."

Reference:- Branch, H.N. The Mexican Constitution of 1917 Compared with the Constitution of 1857. Philadelphia: American Academy of Political & Social Science, 1917, 16.

The longest and most important article in the new Constitution (1917) was number 27, which declared that property was no longer a natural right but a social responsibility.

Article 27 (Main points not already stated above in broad statement)

"The ownership of landssand waters comprised within the limits of the national territory is vested originally in the Nation, which has had and has the right to transmit title thereof to private persons, thereby constituting private property.

Private property shall not be expropriated except for reasons of public utility and by means of indemnification.

Legal capacity to acquire ownership of lands and waters of the Nation shall be governed by the following provisions:-

i Only Mexicans by birth or naturalization and Mexican companies have the right to acquire ownership of lands, waters, and their appurtenances, or to obtain concessions to develop mines, waters, or mineral fuels in the Republic of Mexico.

ii The Nation may grant the same right to foreigners, provided they agree before the Ministry of Foreign Relations to be considered

Mexicans in respect to such property, and accordingly not to invoke the protection of their Governments in respect of the same, under penalty, in case of breach, of forfeiture to the Nation of property so acquired.

iii Within a zone of 100 kilometers from the frontier, and of 50 kilometers from the seacoast, no foreigner shall under any conditions acquire direct ownership of lands and waters."

Reference:- Womack, J. The Mexican Revolution, 1910-40: Genesis of a Modern State. In F.B. Pike (Ed.) Latin American History: Select Problems. New York: Harcourt, Brace & World, 1969, 316-317.

Article 10 set out the principal holding size limitations for landowners.

#### Article 10

"The maximum area of national land that can be held by one person for agriculture or livestock in its various classes, is the following:-

- a) 100 hectares of irrigated land or superior humid land.
- b) 200 hectares of seasonally usable land or of pasture land susceptible of cultivation.
- c) 150 hectares when the land is used for the cultivation of cotton.
- d) 300 hectares when the land is destined for the cultivation of bananas, sugar cane, coffee, henequen, rubber, cacao, vines, olives, cinchona, vanilla or fruit trees."

Reference:- Leyes Mexicanas. Codigo Agrario. Mexico City: Author, 1970, 218. (Translation)



## APPENDIX 2

TESTS FOR NORMALITY OF DATA BASED ON SKEWNESS AND  
KURTOSIS

Method:- For a given population

$$\begin{aligned}\mu &= \frac{\sum x_i}{N} \\ M_2 &= \sum (x_i - \mu)^2 / N \\ M_3 &= \sum (x_i - \mu)^3 / N \\ M_4 &= \sum (x_i - \mu)^4 / N \\ \sigma &= \sqrt{M_2}\end{aligned}$$

where  $\mu$  is the mean,  $M_2, M_3, M_4$  are respectively the second, third, and fourth moments about the mean, and  $\sigma$  is the standard deviation.

For the sample estimates of population parameters

$$\text{let } h_1 = \frac{\sum x_i}{N}; \quad h_2 = \frac{\sum x_i^2}{N}; \quad h_3 = \frac{\sum x_i^3}{N}; \quad h_4 = \frac{\sum x_i^4}{N}$$

Then the sample estimates of  $\mu, \sigma$ , and the moments are:

$$\begin{aligned}\hat{\mu} &= \bar{x} = h_1 \\ \hat{M}_2 &= m_2 = h_2 - h_1^2 &= \sum (x_i - \bar{x})^2 / N \\ \hat{M}_3 &= m_3 = h_3 - 3h_1h_2 + 2h_1^3 &= \sum (x_i - \bar{x})^3 / N \\ \hat{M}_4 &= m_4 = h_4 - 4h_1h_3 + 6h_1^2h_2 - 3h_1^4 &= \sum (x_i - \bar{x})^4 / N \\ \hat{\sigma} &= \sqrt{m_2}\end{aligned}$$

The moment coefficient of skewness  $\gamma_1 = \frac{M_3}{\sigma^3}$

The moment coefficient of kurtosis  $\beta_2 = \frac{M_4}{\sigma^4}$

The sample estimate of  $\gamma_1 = g_1 = \frac{m_3}{m_2^{3/2}}$

and if the sample comes from a population with a normal distribution,  $g_1$  is approximately normally distributed with a mean of zero and standard deviation of  $\sqrt{\frac{6}{n}}$ . Since the approximation is inadequate when  $n < 150$ , tables were used for testing the hypothesis that  $g_1 = 0$ .

If the sample is from a normal population,  $g_2$  is approximately normally distributed with a mean of zero and standard deviation of  $\sqrt{\frac{24}{n}}$ . Since the approximation is inadequate when  $n < 1,000$  tables were used for testing the hypothesis that  $g_2 = 0$ .

Reference:- Snedecor, G.W., & Cochran, W.G. Statistical Methods.  
(6th ed.) Ames, Iowa: Iowa State University Press,  
1967, 86-88 plus Appendix Tables A6 & A7.

## APPENDIX 3

TESTS FOR THE SIGNIFICANCE OF DIFFERENCES BETWEEN  
MEANS

The following three tests were all applied to each of the seven data groups; farm area, crop yield, incidence of double cropping, gross returns per hectare, gross returns per farm, net returns per hectare, net returns per farm.

- (i) The test statistic  $t$  has Student's  $t$  distribution with  $n_1 + n_2 - 2$  degrees of freedom under the assumption of normality of data and equality of variance

$$t = \frac{(\bar{X}_2 - \bar{X}_1) \sqrt{n_1 n_2 (n_1 + n_2 - 2)}}{\sqrt{n_1 S_1^2 + n_2 S_2^2} \sqrt{n_1 + n_2}}$$

- (ii) This test uses Student's  $t$  distribution (as above) but with degrees of freedom equal to

$$\frac{\left[ \frac{S_1^2}{n_1} + \frac{S_2^2}{n_2} \right]^2}{\frac{\left( \frac{S_1^2}{n_1} \right)^2}{n_1 - 1} + \frac{\left( \frac{S_2^2}{n_2} \right)^2}{n_2 - 1}}$$

assuming data are normally distributed.

- (iii) The test statistic  $Z$  has approximately normal distribution with  $n_1, n_2$  greater than 30.

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

References:- (i) & (iii) Brunk, H.D. An Introduction to Mathematical Statistics. (2nd ed.) Waltham, Mass: Blaisdell Publishing Company, 1965, 259 & 183.

(ii) Satterthwaite, F.E. An Approximate Distribution of Estimates of Variance Components. Biometrics Bulletin, 1946, Vol.2, 110-114.

## APPENDIX 4

LIST OF BODIES REFERRED TO IN THE TEXT  
AND THEIR ABBREVIATIONS

AID	Agency for International Development
CFE	Comisión Federal de Electricidad - Federal Electricity Commission
CIANO	Centro de Investigaciones Agrícolas Del Noroeste - Agricultural Research Centre for the Northwest
CIAS	Centro de Investigaciones Agrícolas de Sinaloa - Agricultural Research Centre for Sinaloa
CRF	Comisión Del Río Fuerte - River Fuerte Commission
DAA	Departamento de Asuntos Agrarios - Department of Agrarian Affairs
DAES	Departamento Agraria Del Estado de Sinaloa - Sinaloan Department of Agriculture
IBRD	International Bank for Reconstruction and Development
PEMEX	Petroleas Mexicanos - Mexican Fuels
PLAMEPA	Plan de Mejoramiento Parcelario - Plan for Improving Plot Efficiency
PLHINO	Plan Hidráulico Del Noroeste - Hydraulic Plan for the Northwest
SAG	Secretariat de Agricultura y Ganadería - Ministry of Agriculture and Livestock
SRH	Secretariat de Recursos Hidráulicos - Ministry of Water Resources

## APPENDIX 5

## LORENZ CURVES OF UNIT 2 WHEAT FARMS INCOME

(FIGURES 4a-d &  
FIGURES 5a-d )

4a-d    DISTRIBUTION OF GROSS FARM INCOMES

5a-d    DISTRIBUTION OF NET FARM INCOMES

Figure 4a

## DISTRIBUTION OF WHEAT INCOME, UNIT 2. VALLE DEL FUERTE,

SINALOA - 1969-1970 (LORENZ CURVE)

TOTAL OF ALL FARMS

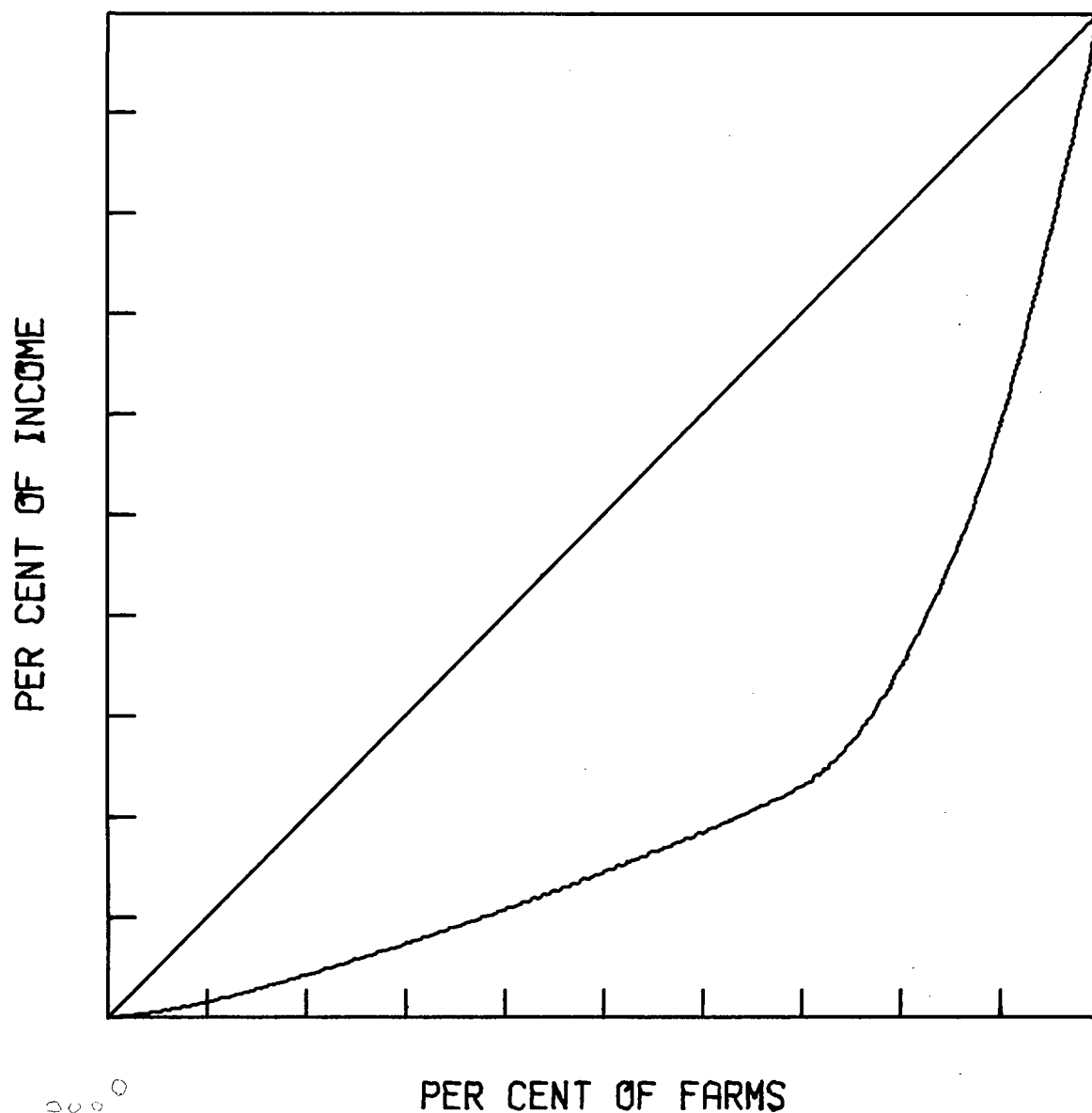


Figure 4b

## DISTRIBUTION OF WHEAT INCOME, UNIT 2, VALLE DEL FUERTE,

SINALOA - 1969-1970 (LORENZ CURVE)

PRIVATE FARMS

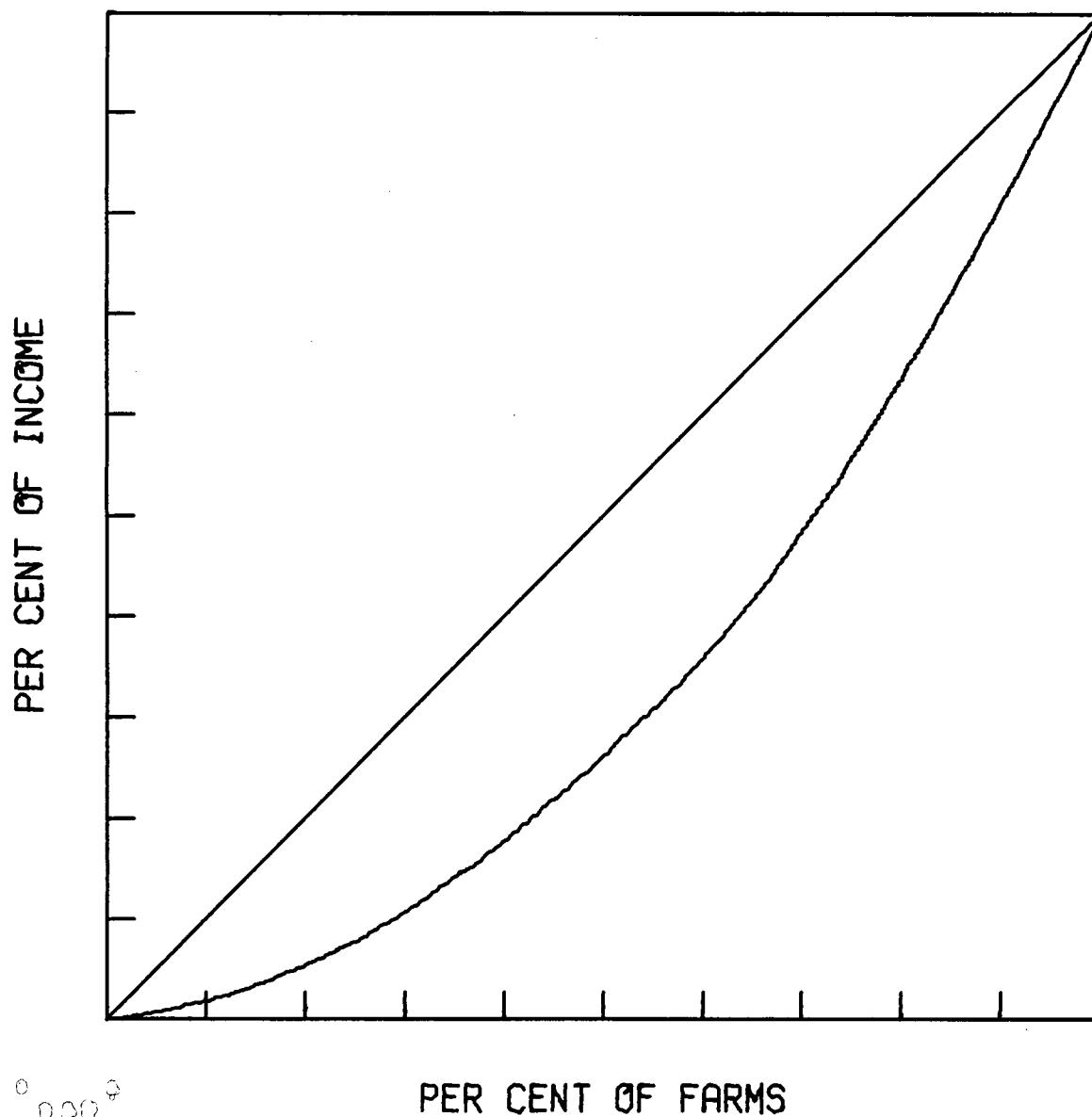


Figure 4c

## DISTRIBUTION OF WHEAT INCOME, UNIT 2, VALLE DEL FUERTE,

SINALOA - 1969-1970 (LORENZ CURVE)

EJIDAL FARMS

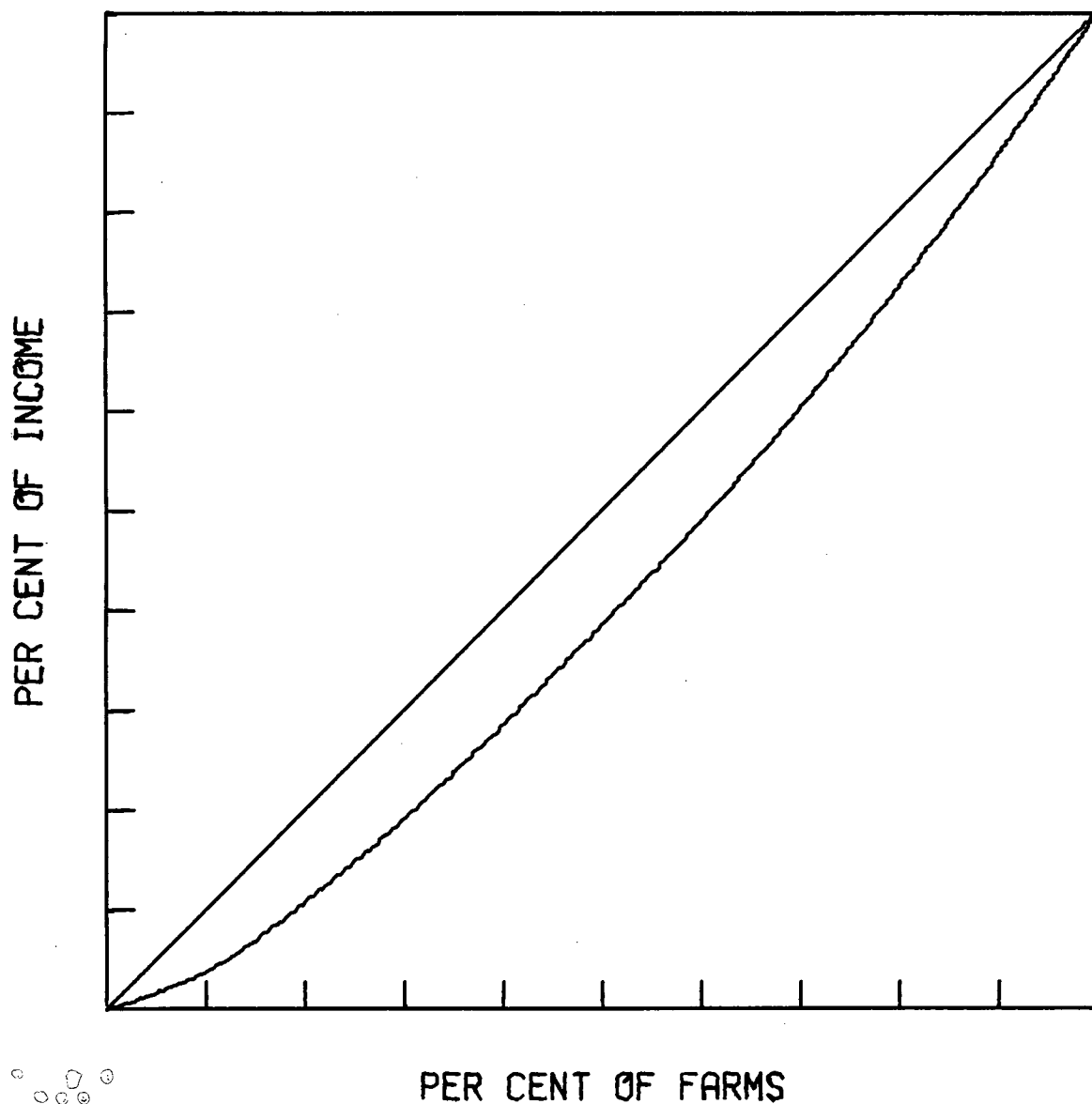




Figure 4d

## DISTRIBUTION OF WHEAT INCOME, UNIT 2. VALLE DEL FUERTE.

SINALOA - 1969-1970 (LORENZ CURVE)

COLONO FARMS

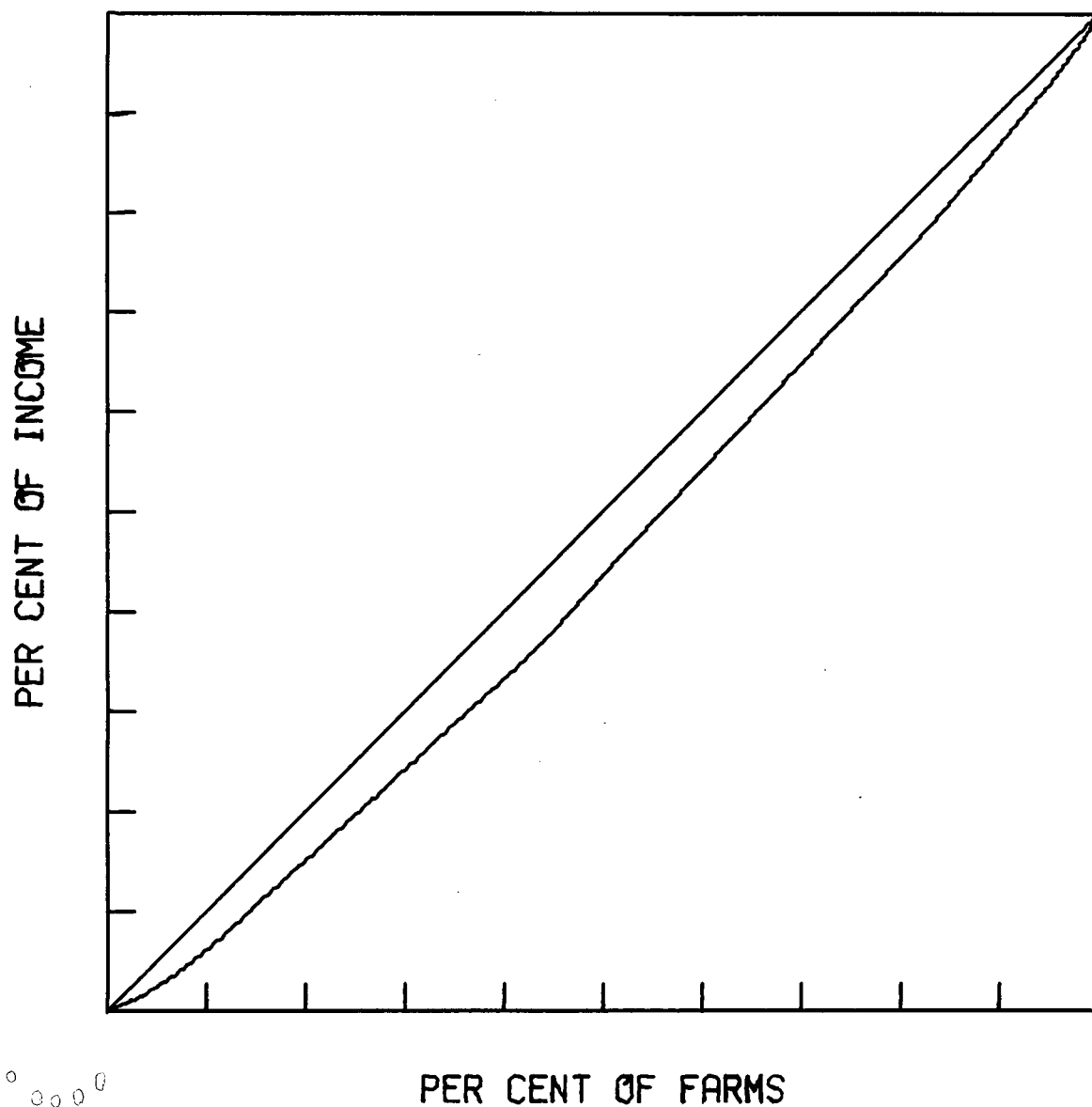


Figure 5a

## DISTRIBUTION OF WHEAT INCOME. UNIT 2. VALLE DEL FUERTE.

SINALOA - 1969-1970 (LORENZ CURVE)

TOTAL OF ALL FARMS

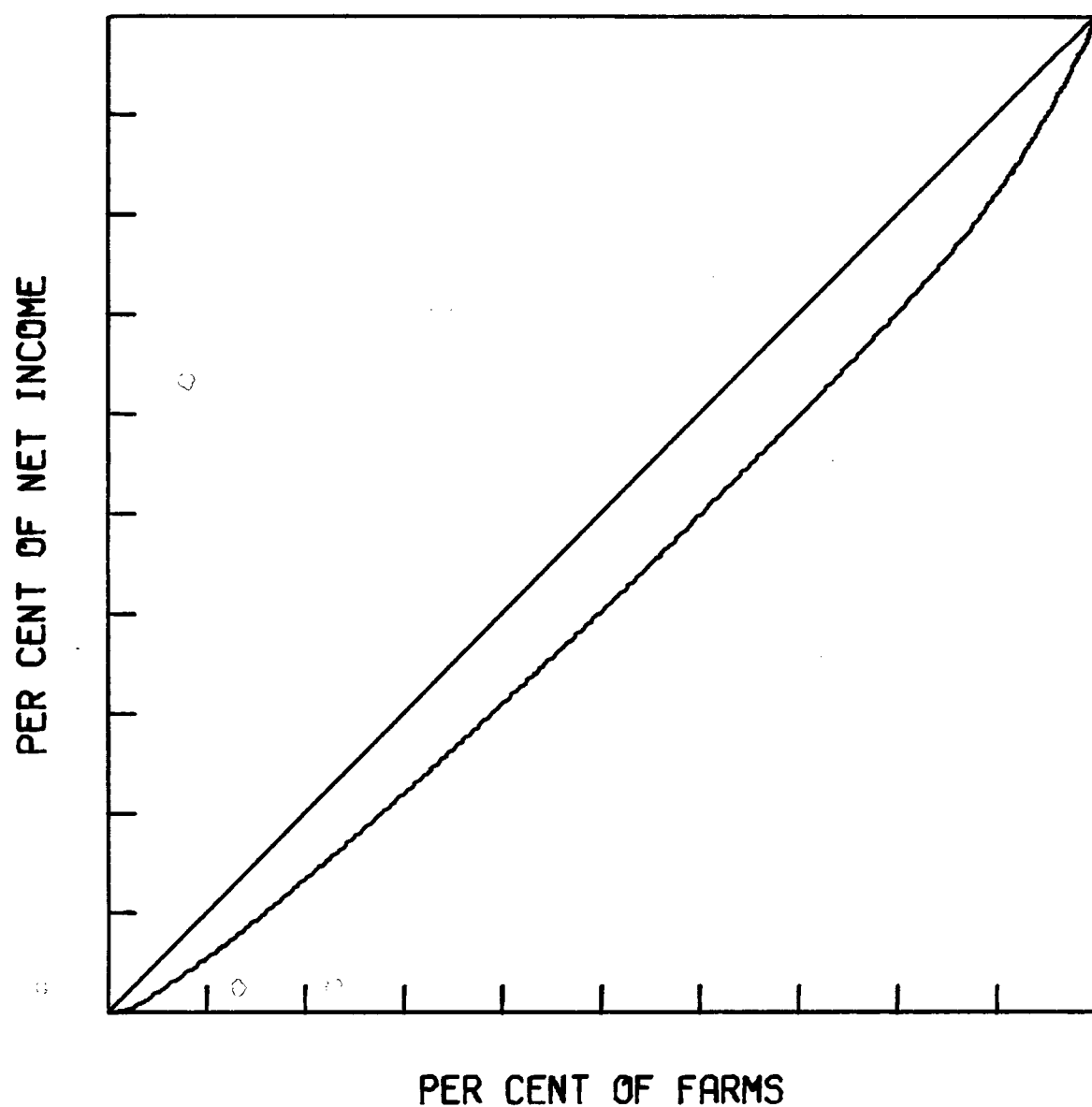


Figure 5b

## DISTRIBUTION OF WHEAT INCOME, UNIT 2. VALLE DEL FUERTE.

SINALOA - 1969-1970 (LORENZ CURVE)

PRIVATE FARMS

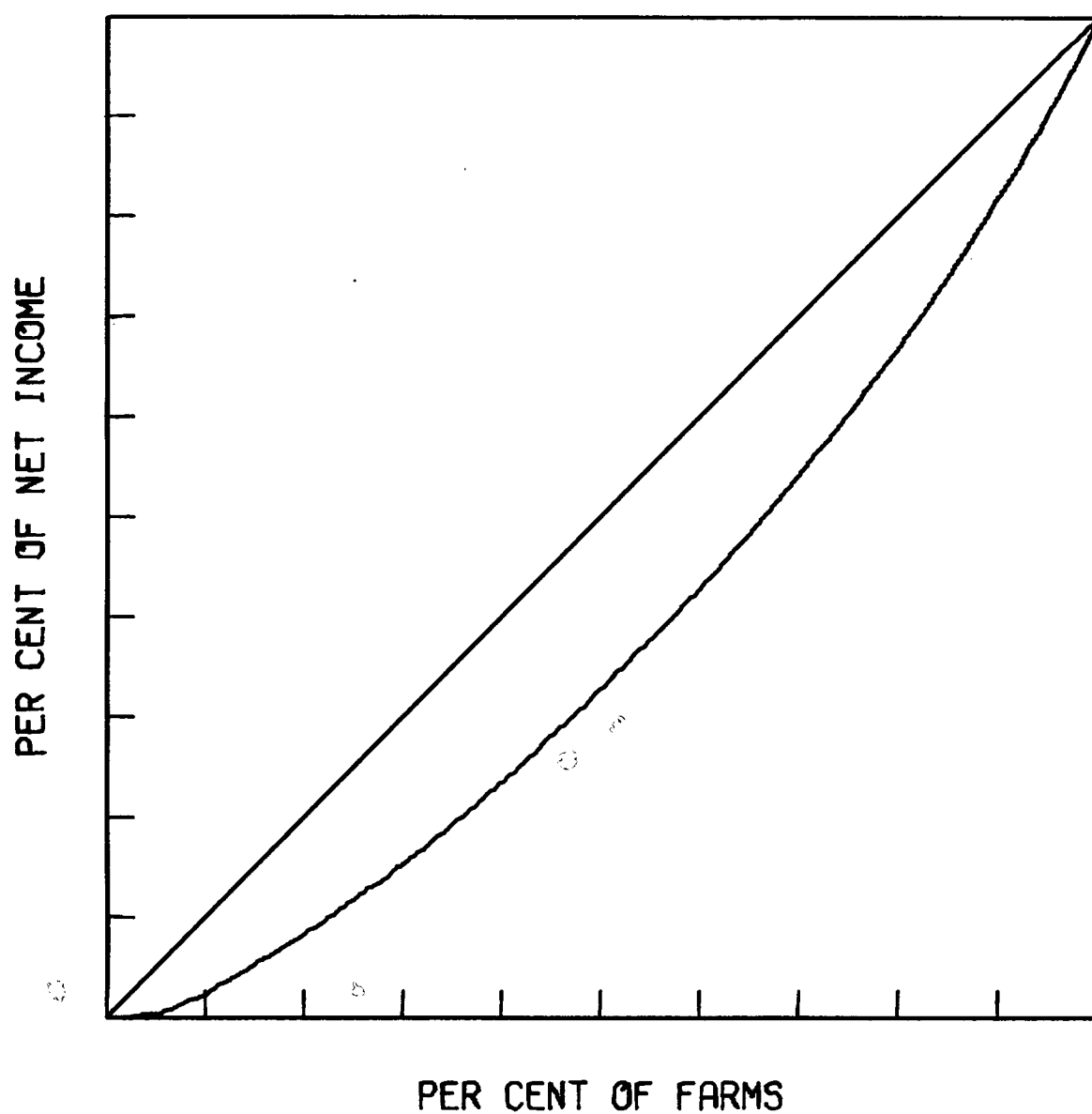


Figure 5c  
DISTRIBUTION OF WHEAT INCOME. UNIT 2. VALLE DEL FUERTE.

SINALOA - 1969-1970 (LORENZ CURVE)

EJIDAL FARMS

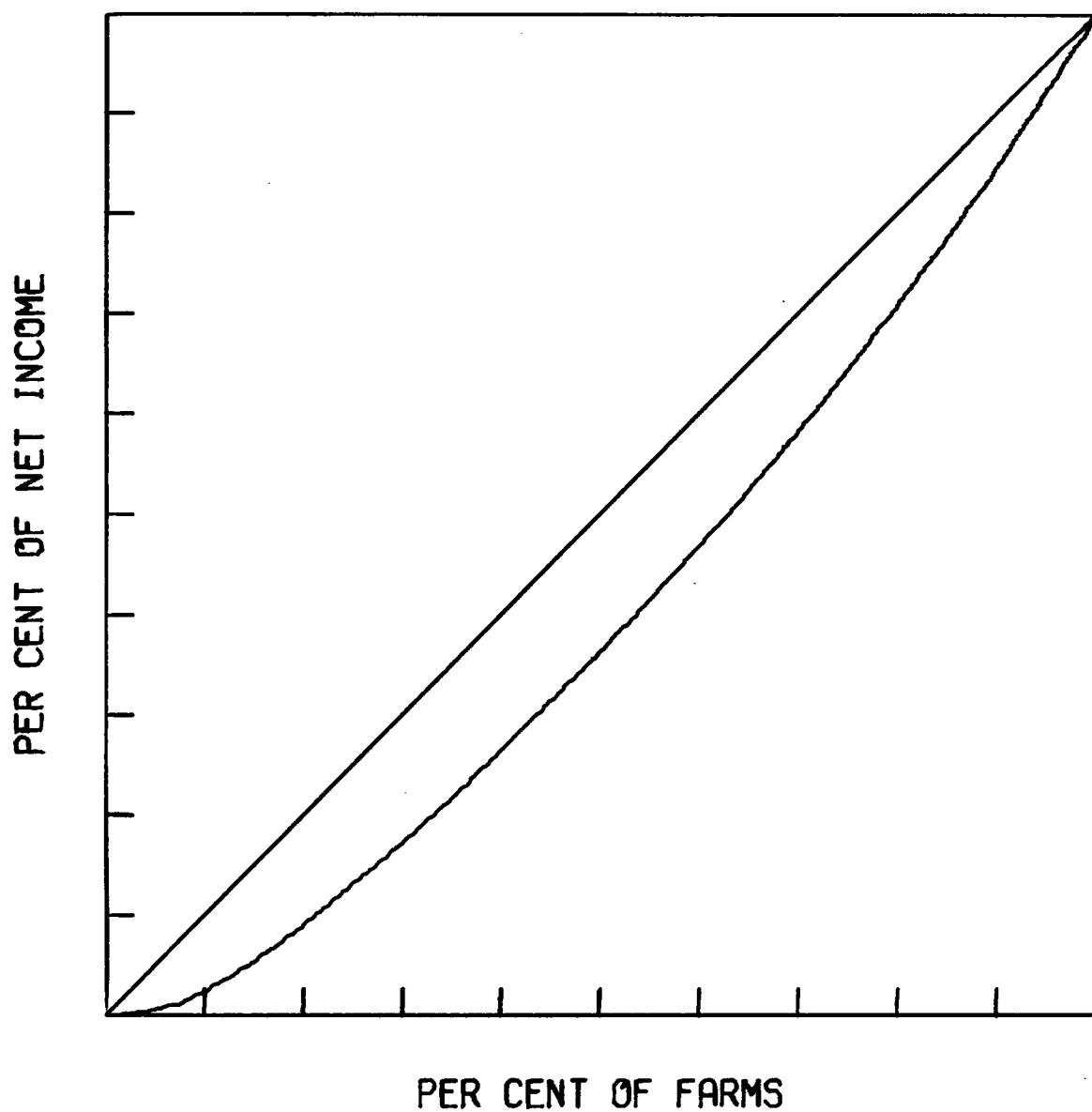


Figure 5d  
DISTRIBUTION OF WHEAT INCOME. UNIT 2. VALLE DEL FUERTE.

SINALOA - 1969-1970 (LORENZ CURVE)

COLONO FARMS

