PHILOSOPHICAL FOUNDATIONS AND CONCEPTUAL BASES OF ADMINISTRATIVE PROCEDURES OF MULTIPLE USE MANAGEMENT OF NATURAL RESOURCES

by

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ABSTRACT

In attempting to determine the background to the controversial term "multiple use," it was deemed necessary to briefly examine preceding social behaviour and legislation. A brief study of early European agricultural practices, through to the Industrial Revolution, allows an insight into the rural background of the early immigrants to North America.

The Conservation Movement of the early 1900s was a result of socially unacceptable exploitation of natural resources and dissatisfaction with the American governments' methods of land disposal in the name of "progress." The rapid demise of the Movement is attributed to its failure to produce practical guidelines for resource management. Subsequent resource development in North America has been fragmentary; a major cause of inefficiency and a disregard for social implications.

The definition of "multiple use" that appeared in the 1960 Act, like the principles of the Conservation Movement, relied on platitudes rather than practicalities. The goals of multiple use are examined, and a new definition is proposed, as is the substitution of "integrated resource management" for the shibboleth of "multiple use."

The history of the development of Canada's resources parallels that of the United States. Yet because of the smallness of the population in relation to the size of the country, the exhaustibility of natural resources has been barely contemplated. Serious public concern for the manner in which Canadian resources are being managed is only of recent occurrence. The responsibility for integrated resource management lies with provincial governments.

Except for the United States Forest Service, the case studies conclusively show that the biggest obstacles to the implementation of integrated resource management, are of a political nature.

Some techniques of economics that pertain to the allocation and distribution of wealth generated by natural resources are examined. While none of these are entirely satisfactory, Benefit-Cost Analysis is proposed as a possible first step toward better control of resource development.

In including man and his social structures within its deliberations, the discipline of ecology gains sounder foundations for analyzing the effects of resource management on society. The application of systems analysis to such complex ecological problems has great potential in allowing management strategies to be explored before being implemented. A hypothetical model is developed in which systems analysis is used to effect integrated resource management.

Such a form of management presently remains as an ideal because of existing governmental, and industrial relations. Since voluntary cooperation for the public welfare appears unlikely in the near future, research will be needed to determine at which level of government to establish a department, whose function will be that of integrating resource management.

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To my wife, Ann, goes an expression of my gratitude for her patience and cheerful secretarial work.

INTRODUCTION

THE OBJECTIVES OF THE STUDY

The objective of this thesis may be summed up as follows:

(a) through the examination and evaluation of past management philosophies to determine how the term "multiple use of natural resources" has evolved, and to assess its meaning under current North American conditions;

(b) to determine how and where such concepts of resource management are being applied, and to attempt an evaluation of the results;

(c) having defined the meaning of, and analyzed case studies where forms of integrated resource management have been implemented, to draw conclusions as to the validity of such concepts of management, and to attempt recommendations for their employment in wider fields, should this be found to be necessary.

THE NEED FOR THE STUDY

The lack of understanding of the meaning, and of recognition of the concepts of multiple use by most resource agencies, has resulted in vague and ineffective discussion as to how, or even if, these concepts should be implemented.

Multiple use has strong social connotations that are predestined to play an increasingly important role in resource development. Thus it is essential that the concepts and meaning of this term be fully grasped by all those responsible for the exploitation of natural resources.

DEFINITIONS

The author has found himself obliged to approach this topic from a philosophical standpoint that is not peculiar to any particular discipline. Since it has become not unusual for specialized fields to impart often esoteric meanings to otherwise commonplace words, the use of such words in this work might lead to some confusion. The following definitions give the meanings of various words as they are used herein.

Wildland:

This word has no exact definition. The United States Forest Service (1959) has classified various tracts of land for recreational purposes as "wilderness," "wild areas," "virgin areas," "scenic areas" etc. which all have aspects of wildland as the term is used here. For taxation purposes in British Columbia, wildland consists of land other than that registered for subdivision into lots, or improved areas of coal land, forest land, timber land and tree farm licenses (B.C. Taxation Act, Section 4). This definition is inapplicable to the context of this work.

As used in this thesis, "wildland" is understood to include any or all of the following categories:

(a) land that has not been influenced in any way by man's activities;

(b) desolate land that is removed from continuing management, e.g. abandoned logged areas and strip mining operations could be included here;

(c) land that is not under permanent cultivation (e.g. agriculture), but which may experience extensive management such as is presently found on some of British Columbia's tree farm licenses; other resource uses such as wildlife, and extensive recreation may also be undertaken without the effects ruining the character of wildland.

While acknowledging that a minimum area must be considered when management of wildland resources is entertained, this thesis does not propose to state a figure.

Resource:

Webster's (1966) definition of a resource as "something that is ready for use, or can be drawn upon for aid" allows further refinement of the word to take either a concrete or an abstract form. Duerr (1960) includes technological skills and knowledge as resources, while in common with other

economists, concentrating attention on the trio of labour, capital and land.

In confining attention to "wildland resources" this thesis deals solely with natural resources, i.e. natural phenomena that have values for man. It is obvious, however, that without inputs of labour and capital many phenomena, particularly the material ones, remain as untapped resources of unknown potential. The differences between renewable and non-renewable resources are discussed on page 132.

Agricultural crops and intensively managed forest plantations are not considered as wildland resources since they owe their existence to man's activities. However, where resources are extensively managed, e.g. wildlife, second growth forest that is supplemented by planting, they are included under the "wildland" heading.

In essence it is the degree of management that the resources experience which determines whether or not the land bearing them can be classified as wildland or not.

Welfare:

In this work, this word is used to denote the well being of a particular individual or group, that results from an optimum combination of resource outputs from a wildland area.

When used with reference to a group or population, society has customarily used the concept of a "majority" as arbiter of the public welfare, public good, public interest (Parker, 1964). In observing this criterion it becomes impossible to avoid conflicts of interests between individuals and the population, and between populations. The resolution of these conflicts is the responsibility of those individuals in decision-making positions. These leaders have, in effect, the power to mould the public interest, no matter how unconsciously this may be done. Thus the decision-making process is an integral part of public welfare, as later chapters will show.

Optimum Combination:

As used in later chapters, it is presupposed that all aspects of wildland resources are capable of evaluation, thus allowing a meaningful optimum to be calculated. The term "optimum" is used in the sense of the Pareto Optimum (Duerr op. cit.) i.e. that the demands upon particular wildland resources and the potential resource outputs can be reconciled, a dynamic equilibrium being achieved such that any movement from it cannot be affected without making more people worse off (in pure economics the units of measurement are monetary), than the number that eventually benefit.

CHAPTER I

EUROPEAN EXPERIENCE WITH NATURAL RESOURCES

INTRODUCTION

In order to survive, every society has had to adapt itself to the environment in which it lives. This has been, and still is, universally true. Populations thousands of years ago moulded the attitudes with which a society views its environment. Such legacies influence social, religious and political behaviour.

During those times when populations migrated they automatically carried with them their outlook of the physical world they had known. With a mixture of tradition, common sense and trial and error, old practices became modified to suit the new environment. In this way, until recent times, people have achieved an equilibrium with their environment whereby a standard of living could be maintained without causing the deterioration of the environment that would necessitate another social upheaval.

Any study of the development of natural resources is, therefore, obliged to examine the traditions and practices of earlier generations. Chapter One presents a brief look at the background of the forebears of the early settlers in North America, in an attempt to determine causes of subsequent behaviour.

There is little doubt that in prehistoric times Central and Western Europe were covered by a mantle of trees, broken only where such mountains as the Alps and Carpathians rose above the tree line (Darby, 1962). Some of the earliest man-made clearings have been dated back to this era but, being solely for the dwelling places of the Mesolithic hunters and food gatherers, they are of little significance to early agrarian development.

Primitive agriculture probably arrived in Europe from the eastern Mediterranean in Neolithic times, when fire and the flint axe became important as tools for clearing land. Though slowly at first, the forest began to be pushed back; the introduction of grazing animals was the factor that was to prevent them from ever regaining their pristine state.

The introduction of the heavy wheeled plough in pre-Roman times was significant in two ways. It greatly enlarged the scope of the farmer who was then able to make use of heavier lowland soils that had been too difficult to work previously. For its operation the plough needed a sizeable team of oxen which no one farmer possessed. This led to the pooling of plough oxen and ultimately to the institution of farming communes (Evans, 1962).

It seems probable that the latifundia (large agricultural tracts) that the Romans introduced to southern Italy in an effort to encourage large-scale agriculture, employed this "pooling" principle. Latifundia reached Europe about the second century B.C., and consisted of a combination of Greek and Oriental agricultural practices. Originally owned by the state, they later became private enterprises that were worked at first by slaves, and subsequently by free labourers in a form of serfdom.

The feudal system became established in the Merovingian kingdoms of northwestern Europe in the fifth and sixth centuries A.D. Under this system the peasants were afforded security in the form of physical security and

sustenance in bad years in return for a fee, paid in service or kind, to the landowner. Monarchies and church holdings accounted for roughly a third of the developed areas of Europe, most of the rest being in the hands of various nobility (Knight et al., 1928). By the twelfth century feudalism was widespread throughout the continent and had reached its zenith.

It is only in recent times that the word "peasant" has come to imply rustic inferiority. Previously the name referred to a permanent link with the soil--"the paysan with his pays" (Evans op.cit.), and is an accurate description of the tenant farmer of medieval times. He depended on the land for all his material needs and upon the seasons that were propitious or otherwise. Much of his world was inexplicable to him, but the existing paganism mingled with Christianity to give rise to superstitions, and thus the unknown or unforseen could always be attributed to spirits or saints. To ensure the success of his activities, and give thanks for harvests, the peasant observed rites and ceremonies that have been handed down in folklore that can still be seen in parts of Europe today.

Superstition notwithstanding, the peasant had a practical side to his nature that served him well. The advent of the large plough had enabled him to break more ground than could be used in one year and so a method of allowing some land to rest, or "lie fallow," for a year developed. The method of using "common land" (i.e. not restricted to a particular individual's use) for grazing purposes also dates back to feudal times, and like fallowing, provided another way of coping with natural and other fluctuations with potentially disastrous consequences.

The forest remained a vital source of fuel and building materials, and in the proximity of villages certain types of forest, notably the open mixed deciduous, were indispensable for fattening swine, and generally sheltering

stock. There is some evidence to suggest that these latter two points dictated the pattern of forest penetration in Europe (Pfiefer, 1962). By the tenth century, mining in central Germany and in the territories of the Magyars and Slavs had reached significant proportions, and the forest was also being used for pitprops and charcoal as well as for the usual domestic purposes.

The peasant farmer with this mixture of superstition and practicality has been the backbone of Europe for many centuries. That his practices have been successful cannot be doubted. Pfiefer (op.cit.) noted, "tilling of soil in Central Europe dates back to Neolithic times yet in the course of more than 5,000 years and considerable historic turbulence, the peasantry has maintained continuous productivity of the land." It is also of note that in this same region, forest still covers more than 25% of the land's surface, and watersheds are still adequately protected.

During the time when the feudal system was at its peak, the forests saw a great deal of activity, namely in the form of man's migration eastward. Darby (op.cit.) drew an analogy between this movement of people from western Germany to eastern colonies, with that of the migration of people from the Atlantic coast west across the American continent six or seven hundred years later.

However, by the thirteenth century the advance had come to a halt; Europe had passed its maximum agrarian effort for the time being (Darby op.cit.). The pattern of settlement stabilized and in some localities there was a reversal of migration. The reasons for this are not clear but can, perhaps, be attributed to general decline in population as a result of war (e.g. the Hundred Years War between England and France) and pestilence (e.g. the black death of 1348). This crisis in medieval development had far

reaching effects, one of which was the ultimate demise of the feudal system.

Landowners began to feel the loss of income and as peasant land became vacant it was engulfed to form larger agricultural enterprises. Growing cities were making increased demands for grain production which were best met by large estates geared to single crop production. The remaining tenant farmers were often forcefully evicted, but because a certain labour force was necessary, the peasants were sometimes retained. Without their holdings these people were virtually enslaved, being reduced materially, and in status, to serfdom. Estates belonging to the church and royalty had enjoyed a reputation for fair treatment of peasants but from this time on economic problems forced them to treat their tenant farmers little better than elsewhere (Knight, op.cit.).

With the coming of the Renaissance Period, the political, religious and social problems of the peasantry were intensified. The use of money as a form of exchange became widespread and this, too, worked against them. If and when emancipation from serfdom was secured, the ensuing freedom had little to commend it--there being little in the way of civil rights and few prospects for employment. Many turned to rural industries to help meet the demands for cloth, pottery, glassware, etc., demands that were growing as cities, particularly those in coastal situations, grew in response to burgeoning shipping routes and trade and a steady inflow of luckless peasantry. The industrial revolution of the seventeenth century introduced the automation which quickly caused the downfall of many rural industries, sending another wave of people to the cities.

By this time the age of exploration and adventure was underway. Many colonies had already been established in various parts of the world and the

colonists were seeking "civilized goods" that could only be produced in the relatively industrialized cities of Europe.

Expanding cities, industrialization and trade placed pressures upon the natural resources of every European country of scales hitherto unknown. The forests were most seriously affected. Not only was timber needed in the cities for construction purposes and domestic fuel, it was also in great demand for shipbuilding and smelting. The increasing requirements for agricultural land was another factor in forest depletion.

The results of continuing exploitation were recorded. John Evelyn, an English scholar and scientist, published an important work, "Sylva," in 1664. In it he noted "the errors of the forest despoilers," for while they were unable to cut down trees fast enough to satisfy demands for shipbuilding and domestic fuel and many Londoners froze each winter, they gave no thought to future supplies. Shortages could only be expected to increase. Similarly in France: Jean Baptiste Colbert, originally involved with the decreasing supply of ship timber, became most concerned about the clearing practices upon the steep hillsides. He noted the effects of forest removal on water regime, water quality and the loss of fertility associated with erosion. In 1669 Colbert published his famous French Forest Ordinances (later to be known as the "Code Colbert"). In this work he dealt with forest management, prescribing silvicultural systems and cutting procedures designed to ensure the improvement of French forests. Similar observations were made in other European countries and various actions taken to protect the forests from complete devastation. But Evelyn and Colbert particularly, because of their astuteness and foresightedness, can possibly lay claim to being among the first modern writers to be concerned about the destructive use of natural resources and to propose remedial measures. In short they were probably the first writers upon the subject of conservation.

CHAPTER II

THE SETTLEMENT OF NORTH AMERICA

INTRODUCTION

At first glance it might seem that the following pages are overly preoccupied with the United States of America. That this is so is not to be denied, and can be explained as follows:

Firstly, the United States has achieved, in less than four centuries, a degree of industrialization based upon natural resources that other countries have developed over far longer periods. This "telescoping in time" greatly facilitates a study such as this.

Secondly, both the history of the country's development and its present status with regard to its natural resources have been well documented and the records made available. This constitutes another factor that makes research, such as that involved in this work, so profitable.

Thirdly, the United States is ahead of most other countires in its level of resource development. This makes observation of it worthwhile, in that its methods can be examined and improved upon or modified before being applied elsewhere.

EARLY IMMIGRANTS IN NORTH AMERICA

Although most of the Europeans who became early settlers in the New World had a common agricultural heritage, it would be wrong to equate them with the medieval peasantry previously mentioned. Many had experienced city life and had lost their connection with the land, becoming tradesmen, shopkeepers, etc. However, most of them shared a common reason for leaving Europe. This was some form of dissatisfaction with social, political and particularly religious restrictions that had developed over the centuries and which they would no longer tolerate.

The New World presented a stiff challenge. Not only did the immigrants face the prospects of a new country, but also a new way of life. In short, they were forced to become almost completely self-sufficient; forest had to be cleared, timber hewn, buildings constructed and crops sown. The change in outlook that must have accompanied this change in way of life must have been profound, to say the least. The removal of social hindrances in the face of a wild abundance of nature gave rise to attitudes that had far-reaching effects. "Once the medieval hierarchy of 'spiritual' over 'temporal' was overturned, competition unfettered and the acquisition of wealth made respectable, a stupendous force for change was unchained." (Knight et al. op.cit.).

The forests of the Atlantic seaboard were the first to feel the brunt of settlement. The land was needed for agriculture and the timber for construction and fuel. Timber not immediately needed was stacked around stumps and burned to prevent them from coppicing; trees too big to be cut were ring-barked and left to die (Chinard, 1945). As had been the case in Europe, fire was a tool widely used in North America for clearing the forest. The apparent abundance of forest was the reason for a lack of concern that resulted in many clearing fires wiping out acres and acres of virgin forest, long before the land was needed for settlement. Swift (1968) told how freely fire was used,

not only for clearing agricultural land, "Children fired the woods when looking for cows; settlers out after summer venison set off dry slashings; and at night during spring and fall, the horizon glowed a develish red from flames that ate away the forest ... and the settlers laughed vindictively as the fire leaped at the trees and young saplings, and destroyed the very life of the soil."

The settlers brought with them the agricultural practices that they knew. Where the new holdings were ecologically similar to the regions where the practices had been developed, they were generally successful. However, the infliction of practices unsuitable to the land that had been taken up, resulted in some successful harvests followed by smaller and smaller ones. This was the story of many southern states, where the plough, followed by such row crops as cotton, maize and tobacco were the cause of wind and water erosion (Pfiefer op.cit.). Upon the loss of fertility the farm was said to have "worn out," and the occupier and his family moved on, taking with him the same techniques to"wear out" other areas.

THE HISTORY OF RESOURCE LEGISLATION IN THE UNITED STATES

The following discussion of legislative history of the United States government with respect to natural resources is based upon the work of Van Hise (1913), and Dana (1956).

The American government saw the settlement of land as the primary means of achieving progress in the country's development. Sales of land were made in 1784, 1787 and 1792, at an average price of seventy-five cents per acre. In this fashion the government hoped to see the country under cultivation and to line the coffers of the treasury department. However, the acreage disposed of in this fashion was small, and in 1796 the General Land Act put up for public sale surveyed land at $1.20 per acre. Still the rate of settlement

was less than the government had hoped for and in 1820 the price was lowered. In 1841 the Pre-emption Law was passed which gave the pre-emptor three months in which to file his claim and thirty-three months in which to pay $1.25 per acre for a minimum of one hundred and sixty acres. However, the interpretation of this law allowed the unscrupulous opportunities to make "dummy entries," and large holdings under single ownership were established "in clear violation of the law's intent" (Van Hise op.cit.). The Homestead Act of 1862, apart from the payment of fees, literally gave land away in parcels of one hundred and sixty acres upon proof of five years' residence, cultivation and improvement. Although this act went some way to achieve the government's goal of establishing bona fide settlers, it too was open to misinterpretation. The act included a commutation clause (allowing purchase after only fourteen months from the filing of a claim) through which individuals and corporations were able to establish claims to considerable tracts of land.

There followed the Mineral Land Act of 1866 and the Coal Land Act of 1873, both of which were intended to grant settlers the right to the respective minerals of a claim, but these were similarly abused, as was the Timber and Stone Act of 1878, which led to accumulation of great tracts of timbered land in the west. The government of the time also disposed of extremely large acreages as military bounties, land grants to colleges and churches and particularly as grants to railroad companies in return for opening up the country. This movement of land from government control into few private hands, was to be a bone of contention in the years to come.

TABLE I

Acreage of public domain disposed of by federal and state governments to individuals and corporations, to June, 1909. (After Van Hise, 1913)

1.	Lands disposed of by cash sale, including pre-emption and commutation homestead sales to 1880, but none since that date	182,515,289
2.	Pre-emption act, July 1, 1880 to June 30, 1909	27,361,836
3.	Graduation act	25,696,420
4.	Homestead act	115,124,295
5.	Mineral and Coal lands	2,047,527
6.	Timber culture act	11,875,785
7.	Timber and stone act	12,566,015
8.	Desert land act	5,149,546
9.	Military bounty	63,958,631
10.	Scrip other than military bounty and agricultural college	1,617,800
11.	Corporation grants	123,718,338
	Totals to individuals and corporations	571,631,482
	Total original domain	1,400,000,000

The middle of the nineteenth century witnessed steady expansion and development of the east of the continent and the serious beginnings of migration westward. The country was filling up and exploitation proper was getting underway.

North American forests have a history of natural fires that can be traced back thousands of years. The extensive areas of slash and logging debris that followed clear-cut logging practices provided the foci for fires that caused the loss, not only of millions of acres of forest and billions of board feet of timber, but also thousands of human lives (Swift op.cit.). As the logger moved from east to west the fires followed him. There was the Peshtigo Fire in Wisconsin in 1871 that was outmatched in all its catastrophic features, except human mortality, by the Tillamook Fires in Oregon beginning in 1933, with fires of comparable proportions across the land in the intervening years (Thirgood, 1961).

The theory that the plough would follow the axe was common among the early settlers. It was the cause of much hardship and the ruination of much land that was completely unsuitable for agriculture. Removal of the Indians from the short grass plains opened up the country for grazing. But as with the forests the range-land looked inexhaustible and huge herds of cattle were established. The resulting overgrazing rapidly deteriorated the range's potential, replacing grasses by unpalatable species that allowed the topsoil to be turned to dust and blown away. The effects of logging, poor agricultural methods and overgrazing found expression not only in the vicinity of these activities, but through the pollution of watercourses and disturbance of water regimes. Populations miles away were forced to tolerate floods and drought.

The effects of the abuse of the nation's basic resources on such a scale were only slowly realized by the American people. The picture was clarified and put into perspective by George Marsh, who published an important work in 1864, "Man and Nature." Marsh had travelled in Europe and had become aware of the growing concern that those countries were experiencing with regard to their limited resources. He had recorded his observations and, upon his return to America, Marsh had synthesized his ideas (Glacken, 1965). From an informed point of view he attributed to mankind the disturbance of the natural balance of life that had been decreed by God. Such imbalances could only be detrimental to the environment and ultimately to man himself. Because of the current rumblings of dissatisfaction with land policies in America, Marsh's book was well received. Whereas in Europe the contrast between virgin land and settled land was deep in the past and all but forgotten, "in America the contrast was real to a single generation" (Glacken op.cit.), and the results of civilization were not all pleasant.

Although there was a general feeling that something was wrong with the nation's exploitive practices, it was the government's method of disposal of the public domain that caused the greatest discontent. Illegal interpretations of laws, fraudulence and corruption were commonplace; the public could only look on helplessly. Writing in 1910, Van Hise said, "the far reaching degeneration of public morals in consequence of defective land laws has extended ... throughout the nation from the humblest citizen to those in high places."

These were the basic reasons for the support that the Conservation Movement received in the early decades of the twentieth century.

CHAPTER III

GROWTH OF AMERICAN CONCERN WITH RESOURCE DEVELOPMENT

THE CONSERVATION MOVEMENT

The last few years of the nineteenth century saw a changed America. The open frontier had disappeared, the whole country had been opened up, natural resources were being converted into private fortunes and the public were becoming more aware and concerned about its rights and policies concerning the national heritage than ever before.

The creation of the Department of the Interior in 1849 and the Department of Agriculture in 1862 (Swift op.cit.), were the first small steps toward collectively protecting natural resources. Apart from these moves, there was little government action toward remedying some of the opportunities for abuse until 1891, when the Timber and Culture Act and Pre-emption Act were repealed. In a more positive vein, that same year Congress granted the President, Benjamin Harrison, the power of withdrawing from private development various forested lands into forest reserves (Van Hise op.cit.).

This Congressional action was the eventual result of a paper presented to the American Association for the Advancement of Science in 1873 by Franklin Hough (Van Hise op.cit.). The paper showed particular appreciation

of the evils that have come to other countires as the result of depletion of their forests, particularly in mountainous regions. Hough was appointed by the government to gather information on the nation's forests: in 1881 the Division of Forestry was established as a branch of the Department of Agriculture. In 1886 Bernard Fernow, a German with a forestry education from his home country, was made head of the Division. But until the establishment of forest reserves in 1891, the Division had no federal forests to look after and had to confine its activities mainly to giving advice to those private foresters that sought it. Initially the reserves were made as a step toward preventing the depletion of the nation's forests; in this way they precluded any use at all--much to the anger of private interests, and by 1897 about thirty-eight million acres of forest land had been reserved (Dana op.cit.). In the same year the Forest Reserve Act remedied the situation: essentially the Act declared that the reserves were "to improve and protect the forest ... secure favourable conditions of water flows ... and to furnish a continuous supply of timber for the use and necessities of citizens of the United States" (McConnell, 1959).

However, legal provision and practical management in a developing country as large as the United States were two very different matters. There were many political and industrial stumbling blocks in the path of successful practice. In 1898, Gifford Pinchot, who was to become the evangelist of Conservation, succeeded Fernow as head of the Division of Forestry. Pinchot had had a year's forestry education in Europe, and with his persistence and active dedication to the application of basic forestry to the American scene, made headway towards the implementation of the 1897 Act. In 1901 the Division of Forestry was made into a Bureau in the Department of Agriculture, with Pinchot as Chief Forester (McGeary, 1960).

Prior to 1905 the forest reserves had been under the control of the Department of the Interior, the personnel of which had less than a smattering of forestry knowledge (Pinchot, 1947). Such a situation was not at all to the liking of the young and enthusiastic Bureau. In 1905, after years of political wrangling, the transference of the forest reserves was made and the Bureau of Forestry became the Forest Service. Until this time federal forestry work involved little more than the preparation of working plans for private forests. Suddenly the Forest Service found itself with the problem of implementing "practical forestry in the light of local facts and needs" (Pinchot op.cit.) on the forest reserves that totalled by this time eighty-six million acres.

The amalgamation of the forest office of the Department of the Interior and the Bureau of Forestry to form the new Forest Service was a large undertaking that Pinchot cheerfully accepted. To this end he set down in the form of a letter a statement of national forest policy that was to be signed by James Wilson, Secretary of Agriculture, and sent to himself. This letter is a landmark in the history of resource management in the United States, and continues to be a keystone of Forest Service policy. Its text merits duplication:

> In the administration of the forest reserves it must be clearly borne in mind that all land is to be devoted to its most productive use for the permanent good of the whole people, and not for the temporary benefit of individuals or companies. All the resources of forest reserves are for use, and this use must be brought about in a thoroughly prompt and business-like manner, under such restrictions only as will insure the permanence of these resources. The vital importance of forest reserves to the great industries of the Western States will be largely increased in the near future by the continued steady advance in settlement and development. The permanence of the resources of the reserves is therefore indispensable to continued prosperity, and the policy of this department for their protection and use will invariably be guided by this fact, always bearing in mind that the conservative use of these resources in no way conflicts with their permanent value.

> You will see to it that the water, wood, and forage of the reserves are conserved and wisely used for the benefit of the home builder first of all, upon whom depends the best permanent use of lands and resources alike. The continued prosperity of the agricultural, lumbering, mining, and livestock interests is directly dependent upon a permanent and accessible supply of water, wood, and forage, as well as upon the present and future use of their resources under businesslike regulations, enforced with promptness, effectiveness, and common sense. In the management of each reserve local questions will be decided upon local grounds; the dominant industry will be considered first, but with as little restriction to minor industries as may be possible; sudden changes in industrial conditions will be avoided by gradual adjustment after due notice; and where conflicting interests must be reconciled the question will always be decided from the standpoint of the greatest good of the greatest number in the long run.
>
> These general principles will govern in the protection and use of the water supply, in the disposal of timber and wood, in the use of the range, and in all other matters connected with the management of the reserves. They can be successfully applied only when the administration is left largely in the hands of the local officer, under the eyes of thoroughly trained and competent inspectors. (Pinchot op.cit.)

The ideas thus stated were elaborated upon in the first issue of a manual, several times revised which came to be known--officially, ultimately--as "The Use Book."

The principles embodied in the letter recognize the following points:

1. Natural resources should not be considered as ends in themselves; they only have value inasmuch as they are in demand;

2. Conservation and use are not contradictory terms, so long as the "permanent value" or sustained productivity is not impaired;

3. In considering specific cases, the industry most important to local interests will be given special attention, while other industries were to be hindered as little as possible. All resources were recognized as being of value to particular groups. The Use Book recognized at least twenty-seven uses of the national forests besides timber production and grazing; these ranged from trails and apiaries to electric powerlines and the protection of game (McConnell op.cit.);

4. In allowing such a multiplicity of uses conflicts would be inevitable, and their resolution should be toward the goal of achieving the greatest good for the greatest number in the long run.[1] This phrase has been vaguely, but often, cited as the fundamental goal of Forest Service policy, yet no one can say who the greatest number are, what is good for them, or how long is a long run. However, in Pinchot's day, when the Forest Service relied more on common sense than technical ability, the phrase was very useful as a criterion for decision-making within the confines of the National Forests.

Under Pinchot's vigorous leadership and scrupulous honesty the Service became a highly efficient unit. The reserves were opened for use and all resources were given consideration from the point of view of local inhabitants. Control of timber cutting, establishment and regulation of grazing fees and forest fire protection were but three of the early problems that the Service successfully coped with.

Whilst it was exemplary in many ways, the Forest Service was the youngest of a considerable number of government agencies that had to do with the administration of the nation's resources. Not only were there separate departments for each resource but in some cases separate departments for different aspects of management of the same resource. Between these agencies there was often a complete lack of co-operation and many in fact were in open competition with each other, to the detriment of efficient resource development (Pinchot op.cit.).

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1 The origin of this phrase is ascribed to Jeremy Bentham, 1748-1832, an English philosopher and political scientist. The Benthamite Society proposed that the phrase "the greatest happiness of the greatest number" should be adopted as the goal of society and the individual (Mill, 1921).

Pinchot, as head of the Forest Service, found himself forced to associate with many agencies and departments between which there was more than a trace of antagonism. Realizing how the goal of rational development was suffering through lack of cooperation Pinchot experienced, judging from his own words, what can only be described as a vision:

> "Suddenly the idea flashed through my head, that there was unity in this complication - that the relation of one resource to another was not the end of the story. Here were no longer a lot of different independent and often antagonistic questions, each on its own separate little island as we had been in the habit of thinking. In place of them here was a single question with many parts. Seen in this new light all these separate questions fitted into and made up the one great problem of the use of the earth for the good of man." (Pinchot op.cit.)

These thoughts in 1907 were the seeds of what was to become the philosophy of "multiple use," but more immediately, they were the foundation of the Conservation Movement.

Although many of the ideas concerning resource development were apparently Pinchot's, he relied on such men as W. J. McGee, Overton-Price, G. Woodruff, J. Garfield, F. Newlands, P. Wells (to risk naming only a few) for more than moral support. But it was President Theodore Roosevelt who, being an outdoors man and dedicated to rational development of the growing nation, played the most important role in seeing those ideas become realities. He accepted the concepts of the "conservation of natural resources" with alacrity: they became characteristic of his administration, part of his political platform and generally known as the "Conservation Movement."

Before Roosevelt's term of office came to an end in 1909, there was considerable activity in the administration of many resources. The year 1907 saw the establishment of the Inland Waterways Commission, whose terms of reference dealt with the control of complete river systems, with consideration being given to all impinging resources. In 1908 the Country Life

Commission was established to investigate the standard of living of rural populations.

The importance of conservation was of such national concern at this time, that springing from a suggestion made by the members of the Inland Waterways Commission, the President called a national conference on conservation. The White House Conference of 1908 was a milestone in conservation history. "Never before in the history of the nation had so representative an audience gathered together ... to consider a great national question." (Van Hise op.cit.) The participants consisted of nearly all the governors of the individual states, other social and political figures, as well as leading scientists. The conference heard a number of papers dealing with the current state of forest, mineral, soil and water resources, with predictions of future conditions if these rates and methods of exploitation were maintained. So impressed were the conferees with the facts presented to them that they drew up a comprehensive list of resolutions dealing with the use of each of the nation's resources, pointing out the extravagances and reckless waste of the past and making it clear that upon the conservation of America's natural resources depended the foundations of the nation's prosperity.

As a result of the White House Conference, Roosevelt appointed a National Conservation Commission. Pinchot was Chairman, and the Commission consisted of four sections assigned respectively to minerals, waters, forests and soils. In succeeding months numerous state conservation commissions were similarly established.

The immediate goal of the national commission was to survey and inventory the country's resources. The subsequent report ran to three volumes, and whilst it assumed only an approximation, it nevertheless formed a basis for quantitative as well as qualitative discussion for future management.

With the premise that resources are not defined by political boundaries, Roosevelt called another conservation conference in 1909 for which he invited the Governors of Canada, Newfoundland and the President of Mexico to send representatives. The assembly became known as the North American Conservation Conference and considered the principles of conservation as they applied to the North American continent.

By this time, the scope of the Conservation Movement had widened remarkably. Included with the familiar subjects of forests, soil and water were such headings as the conservation of child life and manhood, the establishment of parcel post and improved sanitation in Cuba and the Phillipines (McConnell, 1954). In short, conservation had taken under its wing issues of a moral and social nature.

Current thinking was that the shortage of basic resources had been a common cause of the wars that had plagued the history of mankind, and could be expected to continue to be so. (Pinchot op.cit.). Conservation was seen as an antidote and consequently Roosevelt proposed a worldwide conference that would meet in The Hague. By the end of his term of office in 1909 thirty countries had accepted invitations to attend, but President Taft, Roosevelt's successor, saw fit to nullify the assembly.

The end of President Roosevelt's term of office was in effect the end of the most active era of conservation that America has ever known. The following year Pinchot clashed with Taft's Secretary of the Interior, Ballinger, over the proposed disposal of valuable coal lands in Alaska and eventually resigned as Head of the Forest Service.

DISCUSSION OF THE MEANING OF "CONSERVATION"

The impact of the attitudes and legislation of this time have influenced resource management policies of North America (and probably a wider sphere) up to the present day. It would be worthwhile to attempt, as far as possible, to briefly assess the Conservation Movement.

Although the word "conservation" was new to this context, the ideas behind it were basically those put forward by such people as Evelyn, Colbert and George Marsh. In essence these were that natural resources were given to man for usufruct alone: they were to be used for the benefit of all rather than the few, and be handed on unspoiled to the next generation. The contribution of the Roosevelt-Pinchot group was to turn these philosophies into a political movement. As mentioned, the term became widely used and the political concepts embodied in it became identified with Progressivism (McConnell, ibid.).

The term "conservation" has not been, and probably cannot be, clearly defined. Attempts at a definition use any combination of: wise use; preservation and use; good husbandry; use without waste; use with purposeful goals in mind, and more recently, preservation of wilderness or silent areas. Pinchot (1910) set out in his book, "The Fight for Conservation," three principles:

1. "The first principle of conservation is development and use of natural resources now existing on this continent for the benefit of the people who live here now." This helped to allay the fears of those who claimed that conservation was restricted to preservation.

2. "Conservation stands for the prevention of waste ... The first duty of the human race is to control the earth it lives on."

3. "The natural resources must be developed and preserved for the benefit of the many and not merely for the profit of the few." This "anti-

monopoly" line had popular appeal and won the Movement followers. It focused attention on the small man in the face of the powerful few who, at this time, were all tarred with the brush of having obtained their wealth through dishonesty.

The Movement's principles can be defined as utilitarian and egalitarian in nature: its ultimate goal was without doubt "the greatest good of the greatest number in the long run."

The immediate achievements of the Movement can be listed as follows:

1. Considerable areas of land were withdrawn from possible private accession and retained to the government for public management. By 1909 approximately 197 million acres had been reserved (Van Hise op.cit.).

2. The presence of a sympathetic president at the time of public awareness and general dissatisfaction with the exploitation scene resulted in legislation that has continued to influence government agencies in the United States.

3. The ideal plan for conservation would involve complete coordination of all those administrations that have any authority in fields of resource exploitation.

However, the Movement rapidly declined in strength after 1910, and has never since reached the level of vitality of the Roosevelt-Pinchot years. As a political movement conservation was one thing, but for directing management in specific instances it was inadequate. The vague definitions and lack of practicality did not constitute the criteria upon which decisions could be made in the face of conflicts. Once the leaders had gone, all that was left were philosophies and doctrines of almost purely rhetorical nature. The principles themselves were impregnable, being of the highest social and moral calibre. Any opposition to "the greatest good of the greatest number," for instance, would be judged basically evil.

Swain (1963) pointed out another fault of the Movement, namely "a propensity to ignore aesthetic considerations." It neglected wildlife and natural beauty, so entrenched had it become in its utilitarian doctrines. In 1913 Pinchot clashed with John Muir over the construction of the Hetch-Hetchy Dam in Yosemite National Park. Pinchot supported the dam and the result was a personal dislike between the two men for many years (McGeary op.cit.). Over such issues the conservation leaders bickered and eventually splintered the core of the Movement. The principles were just not strong enough to hold these factions together. Prospects of achieving an integrated approach to resource management deteriorated from this time, and have not noticeably improved since.

One reason for the Movement losing public support was that its predictions of national impoverishment if conservation were not adopted had not been proven true. Whereas Pinchot's ideas had gained a firm hold, the reckless abuse of resources during the previous decades had not disappeared, yet no one seemed to be too much the worse for it. On the contrary, the standard of living was, if anything, slowly improving.

Raushenbush (1952), analyzing the continued demise of the Conservation Movement, identified four influences that have "battered away at the old ideal...":

1. The sequence of world wars and depressions rendered the principles of conservation untenable in the face of such emergencies, "it became easier to preach conservation than to achieve it, and easier to ignore it than to preach it."

2. Science has shown that resource scarcities can be alleviated by the production of substitute products;

3. Improved trading communications have meant that a resource in short supply could be expeditiously imported. In other words, the national inventory of a particular resource need not be a limiting factor;

4. The Movement lost some of its popularity because of the fear that it might lead to too much government control, which may not always be the perfect antidote to the evils of the economic market system.

The lack of a precise definition of conservation, neglect of aesthetic values and the dual nature of the Movement's origins (McConnell, 1954) (viz. Marsh's environmental sanctity and Pinchot's utilitarianism), have resulted in a spectrum of attitudes ranging from complete preservation to direct exploitation, each claiming to be following the path of conservation. These varied attitudes are to be found written into the policy statements of almost all government departments. However, a more subtle legacy of the Movement has been left. This is a general awareness of the North American public that the rate and manner in which a resource is developed and used can have far-reaching effects.

AN OUTLINE OF THE DEVELOPMENT OF NATURAL RESOURCES SINCE THE CONSERVATION MOVEMENT

Much has been written about the subsequent development and policy formulation of the agencies in charge of resources in the United States, e.g. Swain (op.cit.), Clepper (1966), and Callison (1967), and it is not proposed to duplicate the works here. Certain trends in the development of each of the major resources can be identified. Using the above literature, except where otherwise stated, these trends will be mentioned in order to provide the background necessary for subsequent chapters.

1. The desire to meet conservation, as well as exploitive demands, became more apparent during the 1920s, when the physical limits of each

resource was clearly realized. To satisfy these demands, intensive management based upon sound scientific principles was inevitable, and research branches of many government departments were established to supply the needed information.

2. The fear of monopolies persisted for many years with corresponding pressures put upon the government to increase the Public Domaine, and to develop resources under its control in a "Progressive" manner.

3. Private landowners were encouraged to seek professional advice and aid to ensure management of their land in a scientific manner. Until recently the federal and state governments were the only sources of such services, e.g. the Clark McNary Act of 1924 made possible aid to private forest companies for comprehensive fire protection and tree planting (Dana op.cit.). During the 1930's farmers were encouraged to actively participate in soil conservation projects.

4. Washington met with only limited success in attempting general enforcement of conservation measures when local knowledge was itself limited. For the most part, however, this situation has been remedied, not only by the government having more information on local conditions, but also by decentralization, i.e. delegation of authority to local agents. The Forest Service had established local ranger stations with successful results under Pinchot's leadership. In 1937, Soil Conservation Districts were formed to give farmers and ranchers power to organize districts solely for the conservation of soil and water at a local level while applying federal and state assistance. The Watershed Protection and Flood Prevention Act of 1954 is authorized to ensure "technical cost-sharing and credit aid to local organizations in planning and implementing works of improvement" for (a) flood protection, (b) agricultural water management, i.e. irrigation and drainage, and (c) non-agricultural water management, "including municipal or industrial water supplies, fish and wildlife development." (Sopper, 1966).

5. Although the conception of a unified approach to management was first mentioned by Pinchot in 1907, disregarding for the moment the work of the Forest Service, the first sign of implementation of this philosophy did not appear until 1928. In that year, the Swing-Johnson Bill was passed providing for the construction in Boulder Canyon, Colorado, of the first multipurpose dam--later named the Hoover Dam. The project was assigned to the Bureau of Reclamation and, when completed, water from the dam would be used for irrigation and hydroelectric power, while the dam itself would control the waters of the Colorado River--the flooding of which had caused immense damage during earlier years. This was the first large-scale federal conservation project based upon multiple purpose objectives; it thus demanded the integration of all those interests involved with the use, disposal and control of the one-river system. The Grand Coulee Dam on the Columbia River a few years later was a similar multipurpose project.

RESULTS OF ISOLATIONISM OF RESOURCE AGENCIES AND PROBLEMS OF COORDINATION

For economic reasons, multipurpose projects could hardly have been avoided. Such cooperation of involved agencies, however, is limited to particular projects, which are few in number, and does not constitute much of a step toward coordination of continuing programs.

Since the turn of the century the number of federal departments, bureaux, advisory boards, committees and offices involved with natural resources has mushroomed. The array is bewildering and the lack of efficiency in resource administration can be recognized intuitively. The goal of coordination of agencies has not entirely been lost sight of, however. In 1949 the Hoover Committee resulted in the establishment of Interagency Coordinating Committees but, lacking a central authority with sufficient power to achieve the goal,

the representatives of the member bureaux and departments have been apparently unable to resolve basic conflicts of interests.

In a special message to Congress in 1961, President Kennedy showed that he was keenly aware of the problem.

> "In the past, (resource) policies have overlapped and often conflicted. Funds were wasted on competing efforts. Widely differing standards were applied to measure federal contribution to similar projects. Funds and attentions devoted to annual appropriations or immediate pressures diverted energies away from long-range planning for natural economic growth. Fees and user charges wholly inconsistentwith public policy have been imposed at some federal developments." (American Forests, 1961)

To implement coordination, the President proposed to issue one or more Executive Orders: (a) redefining responsibilities within the Executive Office; (b) establishing a Presidential Advisory Committee on Natural Resources under the Council of Economic Advisors; and (c) instructing the Budget Director to formulate principles upon which to base user fees and permits. The author has been unable to find what, if anything, became of President Kennedy's proposals.

In a penetrating article, an anonymous writer (obviously familiar with resource policies and the structure of United States Federal Government) set out quite clearly examples of conflict and duplication of agency responsibilities. Mister Z rightly claimed that these were the result of the large number of agencies in this field. No apology is offered for quoting liberally from this paper:

> "Present division and duplications of authority restrict true comprehensive development. They pit agency against agency in jurisdictional disputes and in contention for executive and legislative approval. Consider some random examples. There is a running battle between the Forest Service (Department of Agriculture) and the Park Service (Department of the Interior) over the role of recreation on public lands ... The result is that much of the administrative energy needed to develop recreational facilities is dissipated in internecine strife. The classic example of the wastes of dupli-

> cation is in the water resources development field. Four Departments are involved: Defense (Army Corps of Engineers); Health, Education, and Welfare; and Agriculture. Each Department uses different methods of computing expected costs and benefits from projects; each Department stresses different aspects of water development; each Department views the other's activities with a suspicion that borders on the paranoid." (Mister Z, 1961)

The writer went on to state that the only agency that had any coordinating power, was one that was hardly suited to exert it:

> "Lacking any central responsibility at the cabinet level for resources policy and management the Bureau of the Budget is forced into the role of coordinator and arbiter between the various agencies. Probably in no other area of federal responsibility does the Budget Bureau exercise so strong an influence and leverage over programming.
>
> "The present role of the Budget Bureau exceeds its normal responsibilities. Given the present structure of Federal natural resource activities, it has been the only agency which has any interest in or capability for, developing a truly national resource program. This is particularly important for the development of new programs. New needs require new activities. The evaluation of goals and means to meet these goals require specialized attention and expertise that cannot be provided by fiscal specialists in the Bureau of the Budget." (Mister Z, op.cit.)

Mister Z proposed that a Department of Natural Resources should be formed, and since the present Department of the Interior had a preponderance of responsibility for natural resources, it should be the basis for the new department. There was to be a Secretary and Undersecretary of Natural Resources and activities were to be divided into six groups: minerals, electric power, water, parks and wildlife, land (to include agriculture and forestry) and Indian Affairs, each under the supervision of an Assistant Secretary. Program development would remain as in the past, but within a framework of co-ordination.

The major obstacle to such a transfer would be the

> "...organized special interest clientele of the groups involved. These groups fear that their relationships with the government would be affected ... few (such) groups having a direct interest

in the improved efficiency that could result from reorganization." (Mister Z op.cit.)

The writer concluded:

> "An organization such as this one would not automatically solve all natural resource policy problems. It would nevertheless simplify authority and focus responsibility. It would provide the possibility--now lacking--to develop consistent and coherent resource policies and programs. In the absence of such a change, we can expect nothing better than the present inconsistency, confusion, and deadlock. Change is never easy, but considering the challenge to public policy presented by our future needs for natural resources it is essential. The time is past due for acceptance by the Federal Government of its responsibility to provide clear and decisive leadership in the conservation and development of natural resources. The first and most vital step is to organize a Department of Natural Resources." (Mister Z op.cit.)

It is difficult to see how an integrated complex such as man's environment can continue to be exploited in such a fragmented manner as presently is the case in most parts of the world. With the increasing demands made by continually expanding populations, a unified approach to natural resource development would appear to be essential.

CHAPTER IV

MULTIPLE USE

EVENTS LEADING TO 1960 MULTIPLE USE - SUSTAINED YIELD ACT

Unlike many of the other resource agencies of the Federal Government of the United States, the Forest Service does not have jurisdiction over a single resource, but rather tracts of land upon which several resources are found with an accompanying number of uses. The authority with which the Forest Service administers the "multiple uses" of the National Forests did not originate from a single legislative source or administrative directive.

Timber and water were named directly in the establishment Act of 1897; grazing and minerals received attention in the first "Use Book." Although recreation was mentioned in the 1897 Act under the heading of "occupancy and use," there were no other directives, although there has been legislative authority for special phases and an abundance of later sanctions (Brockman, 1959). Fish and wildlife interests received similar treatment, being first included under "occupancy and use" of the national forests.

In no one statutory provision were all these uses recognized as administrative objectives of the Forest Service. The desire to receive such a

unified directive in the form of a policy statement was one reason for the enactment of the Multiple Use - Sustained Yield Act of 1960.

According to Bergoffen (1962), "multiple purpose" was used synonomously with "multiple use," appearing officially for the first time in the Copeland Report of 1933. In this document the five major resources of wood, water, range, recreation and wildlife were mentioned together within the breadth of Forest Service management. The Report also contained a lengthy description of "The Principles and Practices of Correlated Use under Unified Control." Although the term "multiple use" was not mentioned, the descriptions of the elements of this philosophy were comprehensive, containing all the points of current definitions.

"The middle and later 1930's saw widespread concern for national land use planning, and brought the attention of land managers to the application of resource co-ordination" (Bergoffen, op.cit.). On individual forests in the early 1940's various land-use plans were prepared. It was also about this time that various articles on "multiple use" began to appear in the Journal of Forestry--the official organ of the American forestry profession.

The 1942 Society of American Foresters' meeting, which was to have been held in Salt Lake City, on the general topic of multiple use, was postponed because of wartime activities. Dana, then Editor of the Journal, commented on the postponed meeting. "The programme for that meeting indicates clearly the belief of its organizers that members of the Society need information and perhaps education on the subject of multiple use." (Dana, 1943). This sentence would apparently hint at some confusion and perhaps difference of opinion as to what the term really meant. Another point that Dana made in the same editorial was that in the implementation of multiple use, the greatest problem was the determination of the most efficient evaluation and allocation of land uses. This point has not yet been resolved.

In the autumn issues of the 1943 Journal, nine of the papers that were to have been presented at the 1942 Society meeting were published. Most of these espoused the idea of coordination of all possible uses upon individual areas of land. This interpretation of multiple use has come to be known as the "equal priorities" doctrine. Pearson, a silviculturist, took exception to this interpretation. In his eyes, at least, it denigrated the central objective of the National Forests, which was timber production. To achieve the goal of the "greatest permanent benefit for the public," Pearson proposed ranking prospective uses on each parcel of land (Pearson, 1944). He also pointed out the need for recognizing that in a list of priorities of interests, national take precedence over community, which take precedence over individual interests. Pearson's approach formed the basis of a second doctrine on multiple use that has become known as the "dominant use" school.

In 1958 "Multiple Use Management" became the official term of the Forest Service to describe service-wide multiple use planning (Bergoffen op.cit.).

As the 1950's progressed, increased pressure for space, especially for outdoor recreation, began to be felt. The National Forests near large population centres were particularly hard pressed to accomodate the number of recreationists. At this time, the Forest Service was not particularly noted for its recreation facilities, although they did exist. Consequently, there was considerable clamour for a transfer of national forest land to the National Park Service.

The ensuing conflict is another example of the degree of isolationism in which government agencies existed. Neither side appeared willing to cooperate with the other to achieve the result that would be the most acceptable to the public. In this particular instance it would seem that the Park Service was the guiltier of the two parties by refusing to recognize that the Forest

Service, with its ideas of multiple use and goal of the greatest good, etc., at least had the opportunity to provide adequate outdoor recreation facilities. The Park Service claimed that any form of management (i.e. multiple use) would destroy many of the values of recreation. The intensity of the conflict can be guessed at from the following:

> "... wilderness ideas were pushed through the media of coloured movies and slick paper publications. It is all tax exempt ... by the use of pictures and captions a false and misleading impression is created of the work of the Forest Service. The campaign is dirty and ruthless. The Department of the Interior (or individuals thereof) have also joined in the fray. The National Park Service should await the publication of the Outdoor Recreation Resources Review Commission's publication." (Fischer, 1960)
> (The O.R.R.R.C. report appeared in 1962)

Both the Forest Service and the Park Service were keenly aware of the prestige value attached to jurisdiction of public lands and neither side was willing to sacrifice land for the sake of public satisfaction. The interest the Forest Service must have had in seeing "multiple use" written into its policy can be imagined.

The Forest Service was also conscious of another principle of management that was not explicitly written into its policy. Although there were numerous references to "continued productivity" and "perpetuation of the forests" in legislation that had appeared since the inception of the Forest Service, the principles of sustained yield had never been directly expressed.

In 1960 a bill was introduced that included both the above principles, i.e. sustained yield and multiple use. (For a comprehensive record of the background and political events leading to the enactment of the Multiple Use - Sustained Yield bill, see Bergoffen, 1962.)

The objective of the bill was "to authorize and direct that the national forests be managed under the principles of multiple use to produce a sustained yield of products and services for other purposes" (U.S. 74 Stat. 215).

The competence with which the foundations of the Forest Service had been laid down over half a century ago were confirmed in the statement that the purposes of the act were "to be supplemental to, but not in derogation of the purposes for which the national forests were established as set forth in the Act of June 4th, 1897" (i.e. 30 Stat. 11,34).

McArdle, then Chief of the Forest Service, replying to the question of "why is the bill needed?" gave four reasons:

1. to satisfy the need for a statutory directive to manage the national forests under the principles of sustained yield;

2. there was a similar need for a statutory directive for multiple use;

3. all the renewable surface resources for which the national forests were established should be named under a single statute;

4. enactment of the bill would help to implement the "Program for National Forests" that had been sent to Congress the previous year (McArdle, 1960a).

The bill was passed in June, 1960, and became Public Law 86-517 (see Appendix 1). It adequately met the first three points outlined by McArdle (op.cit.). The five main resources were listed alphabetically, not in order of priority.

During its passage through Congress the bill had gained two amendments. One was a clause that would allow future development of wilderness areas in the national forests. The second amendment saw included in the bill, definitions of both multiple use and sustained yield. The legal definition of multiple use that appeared in the bill was:

> "Multiple use means: The management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for

> some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output." (U.S. 14 Stat. 215)

While the 1960 legislation did not alter the objective of the Forest Service, "multiple use," implying recognition of the total resource complex of tracts of land, employed ideas that were closely allied to those of the Conservation Movement. As pointed out earlier, one of the reasons for the Movement's decline was the lack of precise goals; when removed from the context of the United States National Forests, "multiple use" faces a similar fate, though within the Forest Service jurisdiction it has met with some success (see Chapter VI).

The 1960 Act was not the first or the only time that the controversial term appeared in American legislation. In 1953 a bill was introduced "amending the Act of 1947 and mining laws to provide for the multiple use of the same tracts of the public land and for other purposes" (U.S. 69 Stat. 367). This bill did much to stop abuses and interferences of mining claims with national forest management (Cliff, 1961). Multiple use was not defined.

In 1964 a bill was passed as "an Act to authorize and direct that certain lands exclusively administered by the Secretary of the Interior be classified in order to provide for their disposal or interim management under the principles of multiple use to produce a sustained yield of products and services, and for other purposes" (U.S. 78 Stat. 986). This Act, which became known as the Classification and Multiple Use Act, included a definition of the term identical to the one that appeared in the 1960 Act, with the addition of the

words "present and future" in the first sentence, so that it read, "so that they are utilized in the combination that will best meet the present and future needs of the American people."

Thus in political circles "multiple use" had graduated to contexts wider than those of the Forest Service.

MEANINGS OF MULTIPLE USE

The 1960 legal definition of multiple use did little to clear up the differences of opinion that had begun to appear nearly twenty years earlier, as to what the term really meant.

While it is true that many policy statements of a national nature are so worded as to avoid details and cover all situations and contingencies, they should be so couched that pragmatic interpretation is possible in the face of practical situations. Such is not possible with the 1960 definition of multiple use.

Examination of the Act's definition reveals its weaknesses. For example, line three states that "... resources ... (will be) utilized in the combination that will best meet the needs of the American people." Are these needs material and/or spiritual? Who is to decide what they are? To which sector of the American people do the needs refer? Over what length of time should these needs be considered? Similar questions might be asked of other phrases in the definition, e.g. line six "... areas large enough to provide sufficient latitude for periodic adjustment." In the context of the national forests, the Forest Service has had to assume responsibility for answering such questions, relying solely on the discretion of the man in the field.

To some the vagueness of the definition constitutes its usefulness, but to most, particularly those entrusted with its implementation, the vagueness denies interpretation and effective administration.

Although legally defined, the meaning remained unclear. Consequently there has been a great deal written, particularly, but not exclusively, in professional forestry magazines, attempting interpretation and definition of the term. As Neff (1961) wrote, "Multiple use means different things to different people and very little to quite a number."

Before the Act was passed Connaughton attempted to forestall controversy by stating "... multiple use is simply a concept of management which involves the combination of uses or services of the land in such a way that full utilization is realized consistent with managerial objectives" (Connaughton, 1959). The 1960 legislation, however, was a directive for management albeit a vague one and as such purports to be more than a concept.

Hall (1963) classified some of the then recent interpretations of multiple use into two schools: "equal priorities" and "dominant use." The former he ascribes to the Forest Service, whose interpretation came about as follows:

Many resource user groups, e.g. the National Cattlemen's Association, the National Lumbermen's Association, etc., became very concerned over their fate when multiple use legislation was proposed. Each group sought assurance that its particular resource would not be subordinated to the others. Thus, Forest Service Chief McArdle and Assistant Secretary of Agriculture Peterson were prompted to point out that no one resource would be given emphasis over the others.

> "One of the basic concepts of multiple use is that all the named resources in general are of equal priority, but the relative values of the various resources on particular or localised areas, viewed in the broadest public sense will be considered in the administrative application of management plans." (McArdle, 1960a)

McArdle, in his keynote address to the Fifth World Forestry Congress in 1960, outlined six points concerning the interpretation of multiple use:

1. "(Multiple use) does not require maximum production for all or for any one resource." i.e. non-marketable values are often as important as financial values.

2. "In applying the principle of multiple use to a specific area, equal consideration is to be given to all of the various renewable resources but this does not mean using every acre for all the various uses." (Emphasis added)

3. "Haphazard occurrence of more than one use is not multiple use, positive direction is required."

4. "Multiple use does not require that all uses be practiced simultaneously, but over a period of at least one cycle of seasons." (This point indicates that McArdle was aware of the importance of the time factor in "multiple use" management, though his use of the word "season" is unclear.)

5. "The administrative unit of land to which multiple use is to be applied must be large enough to give sufficient room for periodic adjustments."

6. "Central decision making is a prerequisite." (McArdle, 1960b)

In quoting from the above points, Hall unfortunately sought to make his case by omitting the underlined section in number two. In so doing he misrepresented the intent of the Forest Service, which was attempting to be impartial. (McArdle (1960a) had clearly espoused the philosophy of "equal consideration," not "equal priorities," in an earlier issue of "American Forests.") The points that McArdle made go some way to clarifying the meaning of the term, though they detract little from the responsibility and discretion of the field manager.

Hall (op.cit.) referred to a second category of interpretations which he called "dominant use." Basically this doctrine states that every tract of land is ecologically suited to a particular use, and that with increasing

pressures for resource production, it is difficult to justify using land for any purpose except that for which it is best suited. Other uses may be allowed so long as they are completely compatible with the priority use, i.e. so long as they do not detract in any way from the output of the latter. If, for example, a particular area was found to be best suited to timber production, applying the "dominant use" doctrine, grazing might also be allowed, but never to the point where income from timber was reduced.

Stagner, a proponent of this doctrine, although recognizing that management planning must consider all products and benefits that can accrue from forest land, stated:

> "Followed to its logical conclusion, multiple use means first, classification of lands for the primary purpose for which they are best suited, followed by the management of each class according to its primary purpose. This in turn leads to the identification of those secondary benefits that are compatible with the primary management objectives." (Stagner, 1960)

Starr, in another article supporting this doctrine, attempted to set up criteria by which primary and secondary uses could be identified in the following way:

> "Primary needs for land are those involving production of the essential commodities of food, shelter and raiment ... secondary needs are those involving sports, recreation, wildlife habitat ... The differentiation of these two (classes of) needs are (sic) considered as priority needs." (Starr, 1961)

In the same paper he stated, "... land quality will determine use potential, and use potential will determine ultimate planned use." (Starr, op.cit.)

The fundamental difference between the doctrines of "dominant use" and that which Hall referred to as "equal priorities," is that the latter entertains a social goal. Production of one resource may be decreased when in combination with some other use, so long as the resulting combination is socially more beneficial than single use. Hall (op.cit.) made this clear:

> "... social priorities cannot be set on the supposed 'basicness' of some products, nor can one assert as a social goal the maximisation of per unit output of land, or the maximisation of the quality of some product."

In a footnote, Hall exemplified his point as follows:

> "The exchange value of a good is not determined by the total 'worth' of the commodity if the good had to be obtained in one lump amount. What is relevant is the demand for and cost of obtaining an extra or marginal unit. Thus while food is in some sense more 'basic' than wilderness recreation, the importance of obtaining an extra unit of wilderness may outweigh the importance of obtaining food in a country with a great deal of food and little wilderness." (Hall op.cit.)

Inasmuch as resource development and management can no longer be permitted without social goals, the doctrine of equal consideration of all resources, regardless of potential, is the only one that can be entertained.

It must be realized that in giving equal consideration to the five major resources, the Forest Service does not exclude the possibility that in many cases, tracts of land will be used with but a single product or service in mind, because such will be the "social goal." Wilderness areas are commonly cited as examples, where non-marketable values of recreation take precedence: the introduction of any other resource use would immediately destroy the primary values. Critical watersheds are another example where the value of the area can be maintained only at the cost of excluding all other forms of resource use. The situation was summed up by Cliff as follows:

> "In planning for multiple use, equal consideration is given to all basic renewable resources. However, in application, priorities must be established and concessions made in individual cases depending on the needs of people, and the potential and nature of the resources themselves." (Cliff, 1960)

The meaning of multiple use remained indistinct within the Forest Service but it became more confused when private forestry companies adopted the term.

Many of the large private forestry concerns were in a similar position to the Forest Service in that they had within their power the opportunities to provide a number of other resource uses. These companies quickly realized that unless they too espoused the concepts of multiple use they would be unfavourably compared with the Forest Service. Subconsciously, perhaps, the companies had noted the social aspects of the federal policies; to ignore them would be to engender social pressures that could result in economic losses. Thus the companies were forced to look critically at their public relations programs.

In accepting multiple use many forest companies apparently sought to retain their economic standing by equating social objectives with maximum timber production, i.e. they adopted the "dominant use" doctrine for economic reasons. In this position, they relegated to the federal forests the responsibility of providing non-marketable values, e.g. recreation, pure water, wildlife, scenery, etc. Thus in the companies' eyes, multiple use had a double standard: one for the government and one for private forestry. As much was stated by an official of one of the larger private forest companies of America:

> "First, a redefinition of multiple use is important. Not surprisingly, the definition subscribed to by private land managers is similar to that of government land managers. The timber industry believes that multiple use--a term often misunderstood--is simply the accommodation of a maximum of other compatible uses with the highest single use of the land. The highest primary use of private commercial forest land is the growing of trees for successive timber harvests." (Orell, 1960)

If the highest social use of forest land is timber production then private companies are probably the best suited to achieving goals of maximum volume production. The fault lies in the fact that private agencies are not in a position to make unbiased decisions as to the uses to which areas of land

should be put. Too often company goals of highest financial return have destroyed other values inherent in the area, or excluded their enjoyment.

The present allocation of resources is dependent upon recognition by industry of social needs and subsequent attempts to meet them (there is some evidence of a trend in this direction). Government seldom incurs political and economic problems by overriding company policy in order to provide increased social amenities.

The meaning of multiple use has yet to be resolved. In 1967 the Western Forestry and Conservation Association sponsored a conference entitled "Western Forests for All." The conference commenced with papers from six people, including a housewife and a journalist who had been asked to speak on "What Multiple Use Means to Me." Although such an opportunity for professionals to communicate directly with the public is not without merit, that lay people were posed such a question must surely be tantamount to a confession of ignorance of the meaning of the term on the part of the professionals. The journalists, in fact, said as much:

> "The very format of this Conference suggests that we are still uncertain as to what multiple use ought to mean ... If you professionals feel unsure, what of us on the outside of your industry? I think I can tell you as a reporter ... the American public neither understands what you mean by the term, nor is it particularly sure what it means by it." (Woodward, 1967)

Another section of the same conference was devoted to consideration of the orientation of multiple use to water, forage, minerals, recreation and wood. In each case the speaker attempted to show how his resource could accommodate secondary uses without the primary use losing its status. The conference had entirely aligned itself with Hall's "dominant use" classification. It might be true to say that the conference ended, the conferees went away with their self-righteousness recharged and the principles of multiple use as obscure as ever.

> "The conclusion seems warranted that the meaning of multiple use has not been established either by concensus among natural resource experts or by legislative decree." (Hall op.cit.)

SOCIAL CONSIDERATIONS LEADING TO A NEW DEFINITION

As far as the United States Forest Service is concerned, the goal of multiple use is the same as that of the Conservation Movement, i.e. the achievement of the greatest good for the greatest number in the long run. However, multiple use considerations are limited to wildland resources. There are no pretensions to the effect that multiple use is the saviour of mankind, as was the case with the Conservation Movement. This gives the concept a more positive aura and while many difficulties still exist, there is hope for its implementation.

Scientific advances of recent decades have been the essence of boon and bane to multiple use considerations. Technological advances have resulted in more efficient management of most resources (though many new problems have often resulted). Technology, however, with the concommitant capital investment, engenders specialization in particular directions which inevitably leads to single use of resources. Thus the problems of coordination that multiple use seeks to resolve become intensified. Fortunately there has also grown an awareness of the fact that man's environment, his ecosystem, is a complex unit. Single use is impossible without affecting other resources, or uses of the same resource: these effects are almost invariably detrimental. The case of vested interests and single use versus broader objectives of maximum public welfare constitutes one of the basic problems of multiple use implementation. As previously pointed out, single use is not inherently bad. What is required for the maximum public welfare is a combination of products and uses of wildland resources that meets this objective.

The term "optimum combination" implies a physical limit to the area from which the resources are selected (Ridd, 1965). Such a specified area may be defined geographically, politically or arbitrarily but is a necessary convenience: management cannot be infinite in scope.

Criteria for effecting an optimum combination from marketable and non-marketable resources are presently not available, though attempts at the problem have been made (see Chapter VII). (This problem is one of the few involved in multiple use that is of a more technical than political nature, and hopefully will be resolved with time and effort.)

Concern has been expressed to the effect that there is the possibility that the production of an optimum combination of resource outputs may itself become the goal of management (Miller, 1961). This of course should not be the intent of multiple use planners whose interest in optimization should extend only to the limit that such will achieve the goal of maximum public welfare. A population's requirements of wildland resources will change with time just as the population itself will change. Planners must at least be capable of accommodating and, as far as possible, anticipating changed demands. An inflexible optimum is little better than single use.

Such an optimum combination can only be achieved through planning. It is at this stage that philosophy must prove itself capable of dealing with specifics. There has been almost complete ignorance of this point by those writers who have considered the multiple use concept outside the context of the U. S. Forest Service. Even before planning for a combination of resource outputs can begin, a number of vital points must be cleared up. For instance:

1. for whom is the resource output to be planned?

2. who, and with what authority, will have the responsibility of planning?

3. what is the area available for the production of an optimum combination of outputs?

4. what criteria will be used to interpret physical objectives from philosophical social goals?

The definition of the population of concern is vital since the demands on wildland resources which determine the composition of the optimum combinations must be known, and different populations will have different demands. The problem of localism versus nationalism can be a source of conflict. In many cases the economic benefits that the nation gains from the exploitation of the resources of a specific area will, through the market system, benefit the local population. In other words the local population will benefit by selling needed products of local resources to markets outside the area.

When local and national interest clash, the issue often involves non-marketable values. For example, local industrial activities may affect a rare species of wildlife, the existence of which affords a form of vicarious pleasure to citizens in another part of the continent, who may never see the creature at all. Such citizens are often capable of focusing public concern upon the problem and so directly influencing a local economy. A similar clash of interests might develop the other way round, i.e. local inhabitants may find that their traditional recreation areas have been appropriated for such uses as e.g. water impoundments, that will serve populations far removed from local interests. Such conflicts are not easy to resolve, but national interests should take precedence over local interests in most cases.

One aspect of resource management that has been, and continues to be, controversial involves the requirements of future generations. The Conservation Movement in all its doctrines emphasized the principle of usufruct. In the

early days of the Movement these were based on religious grounds; today they are based upon moral obligations. Orthodox economists have been unable to accept this view. Their alternative states that natural resources are nothing but "a natural form of capital, and may be substituted for man-made capital goods and vice-versa" (Hood and Scott, 1957). This view holds that such capital fluency will benefit society more than handing on to future generations natural resources with options still open as to how, when, where and if conversion should take place. To the proponents of this "Capital Theory" technology can only be beneficial, in that rapid and efficient exploitation of natural resources is what is best for society. This view is not held by modern ecologists who see technology causing as many, if not more, problems that it pretends to solve: se Holling (1968) and Larkin (1968).

On the other hand we have the extreme conservationist, who with a scepticism of economic theories and the market system that amounts almost to contempt, would lock up resources in living museums. Being antipodal to the cold hard facts of the economist, the extreme conservationist (or more correctly, preservationist) becomes so entranced with natural phenomena he sees mankind as separate from and subservient to his environment, elements of which are necessary for survival.

Neither of these extremists appears willing to take a step toward compromise. Few will argue nowadays that the price system of allocating resources is perfect, but it is reasonably effective. Alternatives based on personal values and judgments can be dangerous and equally inefficient (Goundry, 1963). It is not possible to "have the cake and eat it too," but renewable resources can be used to the benefit of present generations and yet the land left in a viable condition so that the next generation may enjoy

similar benefits. Consideration of the future is a valid and socially acceptable requirement of those agencies with jurisdiction of natural resources, and must be included in planning that precedes the implementation of multiple use.

These two points, definition of population and regard for the future, have in some measure been successfully embodied in the multiple use management of the Forest Service. When this concept is adopted by other agencies with control over tracts of land, the problem of implementation is confounded. As with the objectives of the Conservation Movement it is impossible to gainsay the social goals of multiple use. However the adoption of principles has in many cases involved little more than lip-service, few private concerns being willing to fully accept the social implications.

Multiplicity of ownership where multiple use is to be considered is a factor that confounds the problems even further. There is the possibility that multiple use will not be accepted by all owners or agencies; one rejection of the principles involved can jeopardize the project. There is also the possibility that in accepting the principles, interpretations of the goal will be different. In the event of either of these situations, those responsible for planning must have sufficient authority to bring together and resolve differences of interpretations if the goal, i.e. maximum public welfare, is to be achieved.

This discussion has sought to make the following points:

1. that multiple use has a social goal;

2. the achievement of this goal requires the definition of a specified area; and

3. that the population whose welfare is being maximized must be defined (economists use "referrent group" in such a context) and embodied in a more meaningful definition of the term "multiple use."

The following is offered as a more useful definition:

"Multiple use means the application of management strategies to achieve the maximum public welfare from an optimum combination of uses of the wild-land resources of a specified area for the benefit of a referrent group."

"Management strategies" implies that the goals of management will not be confined to the short term, but rather will look ahead and attempt to anticipate future needs and the effects of the use of one resource upon the others. Planning will recognize that concern for the referrent group's successors constitutes a valid aspect of the public welfare. To this end renewable resources will be managed subject to the constraints of sustained productivity --unless social demands direct otherwise.

The achievement of an optimum combination will result from an unbiased integration not only of uses of different resources but also of different uses of the same resource.

Inasmuch as the term "multiple use" has become a widely used shibboleth, it is proposed that it should be dropped from contexts in which the preceeding points are considered important. This thesis supports the use of the term "Integrated Resource Management" (Jeffrey et al., 1969) as an appropriate substitute, and further proposes that meaning of this term be restricted to the above points and the definition given on this page.

CHAPTER V

THE DEVELOPMENT OF CANADA'S WILDLAND RESOURCES

To this author's knowledge, a comprehensive account of the history of the use of Canada's natural resources does not exist. Such a magnus opus should not be beyond accomplishment since much of such history was documented and can doubtless be found in the files of individual agencies of the various governments. The research needed to provide this knowledge is considered beyond the scope of this work, but from a few references a skeleton can be pieced together.

Links with Britain considerably influenced the early development of this country's resources. Recognizing Canada as a colony of the British Empire, Britain was able to exert considerable monopoly and control over Canadian development; all resources becoming automatically crown property. Before 1867 development was on a provincial basis and rights to resources were granted by the crown to the provinces. This situation was confirmed in the British North America Act of 1867. Section 109 states:

> "All Lands, Mines, Minerals, and Royalties belonging to the several Provinces of Canada, Nova Scotia, and New Brunswick at the Union, and all Sums then due or payable for such Lands, Mines,

> Minerals or Royalties, shall belong to the several Provinces of Ontario, Quebec, Nova Scotia, and New Brunswick in which the same are situate or arise."

As a result of this action use of the nation's resources continues to be provincial responsibility. This diffusion of controls and records makes a national history difficult to accomplish.

In attaining nationhood at this time, Canada was unable to benefit from the accumulated experience of the British Colonial Service, some of the branches of which, e.g. the Forest Service in India, had built up enviable reputations of management and administrative efficiency. Thrown upon her own devices, it was only natural that Canada should adopt many of the patterns of resource use that were being developed in the United States (Thirgood, 1969).

Before the days of substantial settlement, Canada was renowned in European eyes for its fur trade. Fur-bearing animals were being exploited long before the timber values of the forests were recognized, and before agriculture was of any import. As the country, particularly the eastern parts at first, were opened up by settlement, the fur trade burgeoned, and benefitted by the increased access to hitherto virgin territory. Adams, writing in 1915, told how

> "The ever advancing network of railways and steamboat communications has made it possible for hunters to carry their provisions and supplies into remote recesses of the continent which have to date been practically inaccessible. The last retreats of the fur-bearing animals have been invaded by their remorseless enemy, man." (Adams, 1915)

Following the American War of Independence, Britain shifted her demands for ship timber to Canadian sources, from those of the eastern United States. This was to stimulate the lumber industry of Upper and Lower Canada to trade more widely, beginning with the northeastern states of America. (Albion, 1926). By the 1840s a thriving lumber industry had sprung up and exports of

rough-sawn lumber were becoming as important as masts and spars (Lower et al., 1938). The history of forest exploitation in Canada has closely paralleled that of the United States. Early settlers saw the forest as a fearsome hindrance and sought to remove it as quickly as possible--fire being the main clearing tool. Demands for pulpwood at the turn of the last century added to the depleting effects of the lumber companies' clearings.

Another export that had reached significant proportions by the 1840s was that of cereals, particularly wheat (McFarlane, 1965). Agriculture was regarded as the key to settlement and progress and, as in the United States, the provincial and later the Dominion governments encouraged agricultural settlement. However, in this pressure for settlement, inexperienced people were persuaded to take on the job of farming in areas not really suited to such use. This situation caused hardships and problems for settlers that have still not been fully overcome (see Blythe, 1967). Attempts at inflicting orthodox agricultural practices in the prairie regions met with the same results as had been experienced in the grasslands of the United States. Exposure of the top-soil to wind resulted in drifting; the onset of seasonal rains caused erosion, and the end result was something akin to desert conditions (Royal Bank of Canada, 1958).

The value of Canadian water resources for the production of hydro-electric power has been recognized for more than half a century (Adams op.cit.). Sites for such power production have been developed concurrently with technological advances and as demands were felt.

The discovery of gold in British Columbia in the 1800s and in the Yukon in 1896 was a tremendous stimulus to open up the western parts of the country. Prospecting in Canada's wildernesses has been a common activity since these

gold-rush days, and the rewards have been as large though less spectacular. Discoveries show that this country is exceptionally well endowed with an abundance of most of the minerals important to modern industry (Canada Year Book, 1968).

Whereas control of the above resources lies with each provincial government, the fisheries resource has been maintained under federal jurisdiction (Goundry, 1965). Originally specified by the British North America Act, the Federal Government has control of coastal fisheries but administers inland fisheries in accord with provincial recommendations.

As the need arose there was instituted in each province a government department in charge of the development and exploitation of each natural resource. When dominion status was achieved there was a requirement for the federal equivalent of provincial departments. This does not mean that control and management of the resources shifted from the provinces to the federal government. However, some coordination of provincial resource policies on a national basis was envisaged. The Federal Government hoped to be able to facilitate research and marketing on a national scale, to provide advice and financial assistance where needed and when possible, without directly influencing provincial responsibilities.

While the exploitation of Canadian resources has borrowed freely from American experience, and federal government departments have been instituted on a similar basis to their southern counterparts, the degree of concern that has been shown for Canadian natural resources has not, until comparatively recently, approached that of the American people. The following reasons are offered as explanations for this phenomenon:

1. the population of Canada is roughly one-tenth that of the United States, and occupies a larger country;

2. due to various physiographic features, viz. topography and climate, the full potential of Canada's natural resources has not been fully realized. In other words, Canada's resource frontiers are still open;

3. although exploitive practices applied to Canadian resources have been little different to those of America for the reasons given in 1. and 2. above, very little national concern for natural resources has been expressed. The feeling that the resources of this country are without limit, that there is still room to expand, continues to prevail;

4. where concern has appeared, it has generally remained within the boundaries of individual provinces, thereby reflecting the autonomy that each provincial government has;

5. for the most part, provincial governments have maintained public ownership of the land in their control. Thus there was no disposal of land in the scale and manner that caused such a reaction in the United States.

Consequently, the Conservation Movement that became such an all-embracing crusade in the United States, never gained a strong foothold with the Canadian public. However, some of the American conservation ideas were copied by both dominion and provincial governments.

In 1895 the first national forest reserves were set apart. These were small areas "located in the thinly timbered areas of the west mainly to protect water supplies to lower agricultural regions, rather than to perpetuate a timber harvest" (Rodgers, 1951). (These reserves were probably in areas that had not yet gained provincial status.) Early provincial reserves, mainly in Ontario and Quebec, had been set up for the primary purpose of fire control, and were in areas that carried commercial timber. At first all use was excluded, but this apparently caused little friction between government and logging companies--perhaps because there was an ample supply

of timber in unreserved areas. Since that time provincial reserves have been opened for use and production, and reasonably amicable relationships between government and industry have prevailed.

Canada's first national park, Banff, was instituted in 1885, to be followed by Glacier and Yoho National Parks in 1886. By 1913, when the Forest Reserves and Parks Act became law, dominion reserves totalled 35,800 square miles (Rodgers, op.cit.). By this time the purpose of the forest reserves had shifted from protection to perpetuation of harvests.

The Canadian Forestry Association was organized in 1900. In 1906 a public Canadian Forestry Convention was held under the auspices of this Association. While the main theme of the Convention was oriented toward forestry, the effects of the politically active Conservation Movement in America were obviously being felt. Topics broadened and embodied the relationships of forests to water resources and agriculture (Thorpe, 1961). The conclusions arrived at by the Convention were basically those of

1. the desirability of maintaining forests under crown ownership;

2. measures should be taken toward sustaining and expanding forest harvests; and

3. education that would improve professional and scientific forest practices and administration was very desirable.

Many of the ideas were forward looking; their implementation in many parts of Canada's forestry scene would be advantageous today.

Canada was invited, and took part, in the North American Conservation Conference that was sponsored by the American Conservation Movement in 1909 (see page 25). The Conference came to an agreement on a Declaration of Principles, and these are still of significance in the light of current resource problems. In brief the points made were as follows:

1. General: resources were to be developed and used conservatively in the interest of mankind;

2. Public Health: included here were such topics as water pollution and town planning;

3. Forests: recommendations similar to those of the 1906 Canadian Forestry Convention were proposed;

4. Waters: emphasis on public ownership and multiple use of streams in accordance with a list of priorities;

5. Lands: adoption of measures to ensure productivity and prevent the establishment of monopolies;

6. Minerals: advocation of the use of water power to prolong the supply of non-renewable resources--again emphasis was given to the continuance of public ownership;

7. Wildlife: proposals to the effect that game should be protected and preserved;

8. Commission of Conservation: each participating country agreed to establish conservation commissions similar to the ones in the United States. (Thorpe, op.cit.)

Prime Minister Laurier and his cabinet acted quickly on the formation of a Conservation Commission. Before three months had elapsed since the conference, the principles required for the formation of such a body had been passed. The Canadian Commission of Conservation was given federal and provincial representation as well as university support, and was chaired by Clifford Sifton (Adams, op.cit.).

The work of the Commission was delegated to six main committees, viz. forestry, lands, fish and wildlife, water, minerals and fuels, and public health. Whilst these encompassed the fields in which the Commission was

engaged, its actual function was apparently not too well defined at first. Not until 1918 did Sifton attempt to clarify matters.

> "It is not the duty of this Commission to act in an executive capacity ... Our duty is to investigate, enquire, advise and inform. While it will occasionally become necessary for us to do things ... falling within the function of a government department, (such action will never be) to a greater length than is necessary to arouse interest, to point a way to improvement (and) to collect information necessary to an 'intelligent judgment'." (Armstrong, 1959) (Original emphasis.)

To a considerable degree the Commission succeeded in its aims. Demonstration farms, water power inventories, consolidation of national health services, housing and town planning, studies of mineral and energy resources and mining, and the fostering of national parks and game preserves were some of the Commission's achievements.

However, the Commission was not to have a long life. For all Sifton's remarks of 1918, the Commission began to assume the functions of a federal research agency and this led to friction between Commission staff and the heads of departments whose work was being duplicated. This fact plus a general feeling that the federal government had accumulated more than its share of power during the wartime years, helped to put Canada's Conservation Commission in a poor light.

Sifton resigned in 1919, perhaps because he foresaw redundancy for the Commission, many of whose brainchildren had matured into federal bureaux and departments (Armstrong, op.cit.). Sifton was not replaced, and his leadership was sadly missed. In 1921 a bill was passed repealing the Conservation Commission Act.

While many of the charges laid against the Commission were supportable, it was a great pity that reform rather than dissolution was not proposed. The Commission had served the purpose of "stimulating and coordinating the

rational development of natural resources by all levels of government and private enterprise" (Thorpe, op.cit.). To this end the Commission provided a national forum for discussion of topics related to resource development and a means of publishing papers emphasizing the social aspects of the nation's resources. No other federal agency has held a position with such opportunities for at least contemplating an integrated approach to the nation's resources. The dissolution of the Conservation Commission can only be regarded as a loss.

Although the Canadian economy has depended on natural resources as much, if not more than, that of the United States, the political side of conservation, as exemplified by the Progressivism of Roosevelt-Pinchot times, never became established. Yet many of those conservation principles that pertain to natural resources have found their way into the policy statements of most agencies concerned. Poor management and wasteful exploitation of the nation's resources have been sporadically deplored by individuals (e.g. McConkey, 1952) but none have made realistic suggestions for improvement.

The depression years stimulated research into management practices of most of Canada's resources, particularly forest products and agricultural diversification. Problems of irrigation and erosion in Alberta and Saskatchewan and the generally depressed state of agriculture, resulted in the enactment of the Prairie Farm Rehabilitation Act in 1935. This regional (interprovincial) program now encompasses two and a half million acres (Canada Department of Agriculture, 1966), and within its limited scope of improving cultural practices and water supplies, has been reasonably effective.

The second world war was instrumental in ending the depression and bringing about a new economic status for the nation. With the future in mind the federal government in 1943 set up an Advisory Committee on Reconstruction "to make a thorough study of all areas of economic and social life

in Canada and to make a blueprint of society which was to be established after the war" (Thorpe, op.cit.). A Conference on Reconstruction was called in 1945. The subcommittee concerned with natural resources reported that resource development should be considered as a unified problem. The subcommitte proposed the establishment of a National Development Board, which was to be advised in turn by regional committees representing all resources. Other subcommittees reporting at the 1945 Conference made a number of valuable suggestions involving the development of the nation's resources. The Conference provided an opportunity for consideration of resources on a national basis, that had not been available since the Canadian Commission on Conservation.

As valuable as this Conference had been, apparently it did not leave a permanent mark in the form of legislation, further discussion etc. In 1958 Prime Minister Diefenbaker proposed calling a national conference on conservation. He thus summoned to Ottawa ministerial representation from the provinces to prepare such a conference, the objectives of which were to be:

1. the "identification of the major problems requiring attention in the renewable resources field;

2. the examination of what is being done to solve these problems;

3. the clarification of the impediments to further progress and possible courses to achieve solutions to these problems." (Kristjanson, 1961).

The result of subsequent deliberations was the "Resources for Tomorrow Conference" of 1961, that heard a considerable number of papers dealing with the major natural resources from all points of view, i.e. surveys and inventories, planning, administration, as well as social implications. A considerable portion of the Conference dealt with regional planning and industrial problems.

At the end of the conference, Diefenbaker quite unexpectedly announced that the Conference's steering committee would become a continuing organi-

zation. This was the conception of the idea that led to the formation of the Canadian Council of Resource Ministers (Williston, 1968).

Since becoming formally constituted in 1964 the Council has worked on well over one hundred projects, a number of them springing directly from proposals of the 1961 Conference. Although the Council does not have legislative authority it has nonetheless a significant role to play. Williston (op.cit.) tentatively defined its functions as follows:

> "This Council is not a policy formulating group: neither is it a decision-making body. The Council can agree, but even when it agrees it only expresses a consensus that is not binding on anyone. Each and every single government of the eleven governments in Canada retains full responsibility for formulating its own policies, but in doing so, each government has the benefit of a consensus formulated by this group. It is a consultive body, possibly an advisory body. It is a Council existing to assist the free exchange of information. It provides us with improved communication and in so doing, brings us closer together for co-ordination which we in politics will agree is worthwhile."

In other words, the Council can do little more than make recommendations; these, however, can be of a general or specific nature. To date the Council has published a number of works including an important three-volume work, "Pollution and Our Environment" in 1967, and publications on Canadian water resources and outdoor recreation in 1968.

While Canadians have not been oblivious of the trends in resource management in the United States, it is only relatively recently that thought has been given to a unified look at this nation's renewable resources.

Multiple use received some attention at a National Forestry Conference held at Montebello in 1966. Looking ahead to the year 2000, Brooks and Eidsvik (1966) were of the opinion that the outdoor recreation boom had yet to be felt by Canadian foresters, but when it came it could not be ignored. The emphasis of this paper was mainly on the reconciliation of recreation activities within the forest, to timber production.

The Canadian Council of Resource Ministers is apparently becoming aware of the need to "look at all resources in terms of the needs of the Canadian people" (Williston, op.cit.). At this national level there is a growing awareness of the interdependence of resources and of the requirements for optimization. Yet nothing in this direction has yet materialized as formal policy.

The degree of autonomy of the Canadian provinces, however, renders the achievement of coordination of resource policies on a national scale virtually impossible. Provincial governments, as central decision making bodies with responsibilities to a defined referrent group, and a specified area, would appear to be in ideal situations to implement integrated resource management. Yet no evidence in this direction can be found. The reasons are not hard to find. On the one hand, the comparatively small populations living in, or with access to, large areas of land still have room to move if and when dissatisfaction is experienced with life in one locality. On the other hand lies the fact that to most of the provincial governments, exploitation of resources is still directly equated with progress. Like most other governments, they suffer from a diversification of control of resources, and sometimes a duplication of responsibility, so that when exploitation does take place it either occurs haphazardly, or with but a single narrow goal in mind.

Public concern for the Canadian environment is growing, and sooner or later provincial governments will be forced to face the problems of integrated resource management. To suggest how a provincial government should begin to implement integrated resource management would require a thorough study of the natural resources and governmental structure of a particular province; such is considered outside the scope of this thesis. Questions that would have to be faced will include the following:

1. What are the natural resources of the province, and what are their potentials--as far as they can be foreseen?

2. What do the residents of the province (i.e. referrent group) require of these natural resources?

3. How can these requirements be most expediently communicated to the decision makers?

4. Should the province be treated as a single unit for the implementation of integrated resource management, or should it be subdivided into smaller management units? (See Chapter VI and Ontario's Conservation Authorities.)

5. Should the responsibilities of an existing government department be redefined to include the greater legal and fiscal powers that will be required for integrated resource management, or should a new department be established? (See Chapter VI, the Delaware River Basin.)

6. What criteria, or techniques, should be employed to deal with the problems of financial versus aesthetic considerations? (See Chapter VII.)

CHAPTER VI

CASE STUDIES

INTRODUCTION

Multiple use, or integrated resource management, has only been truly attempted in a few instances. It will be worthwhile to briefly analyze one or two examples to see how goals have been determined and administrative mechanisms developed, to implement programs that involved a unified approach to the use of a region's resources, with a specific population in mind.

THE UNITED STATES FOREST SERVICE

As shown in the preceding pages, the United States Forest Service has been intimately connected with both the Conservation Movement and the evolution of the theories and principles pertaining to multiple use. As the Forest Service is the only agency that specifically has multiple use as one of its functional objectives it is an obvious candidate for discussion. (The term multiple use will be used in this section since it is completely within context.)

A few statistics of the Forest Service management program will help to show the considerable importance of the National Forests to the nation. The

Forest Service has control of 154 National Forests and 19 National Grasslands,[1] totalling 186 million acres (about 8 per cent of the country's land area). In 1968 the National Forests sustained 157 million visitor days of recreation; 12 billion board feet of lumber were cut, and over 1.25 billion trees were planted. More than 15 million acres of the forests have been set aside as wilderness or primitive areas; the forests also carry more than 6 million head of sheep or cattle and, in 1968, some 660 thousand head of big game were taken by hunters. Thousands of acres were being treated for control of erosion, as well as hundreds of miles of stream banks and abandoned roads being stabilized. The Forest Service is actively cooperating with state and private forest owners, particularly in the field of fire protection, and is also carrying out numerous programs from nine regional Forest Experiment Stations. (U.S.D.A. Forest Service, 1966, 1969.)

At the head of the Forest Service is the Chief Forester, who, with a staff of professionals, has the responsibility for the management of the National Forest system. (The following description of the administration is based mainly on Cliff, 1961).

The National Forests are divided into ten regional groups (seven to twenty forests in each region), with a regional forester in charge of each group, aided by an assisting staff.

Each individual forest is in the charge of a forest supervisor. Like his superiors, the supervisor has assistants, each of whom is an expert in a particular field of forest management.

The forest is subdivided into between three and ten ranger districts, each with an area of approximately a quarter of a million acres and each in

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1 National Grasslands were originally submarginal farmlands on the Great Plains. They were put in the charge of the Forest Service in 1960 to be managed under the principle of multiple use and sustained yield. (U.S.D.A. Forest Service, 1969).

the charge of a district ranger. The district is the working block, the operating unit of the forest that has its own management plan which translates directives from above into specific programs.

Multiple use planning procedures used by the Forest Service consist of three major steps:

1. The establishment of over-all policies and objectives and multiple use requirements. The preparation of these guides are the sole responsibility of the chief and his staff. Statements made upon these matters must reflect national tendencies, trends and demands, and because of the immense diversity of the national forests they can only be "rather vague and philosophical in nature" (Cliff, op.cit.). With these statements made, the degree of multiple use coordination can be established. This will direct the extent or manner in which the management and use will be intensified for increased production, or modified to prevent, minimize or resolve conflicts. At this level these requirements can be little more than statements of principles.

2. Preparation of regional guides for multiple use planning and coordination. This is the responsibility of the regional forester and his staff. Within the guidelines established by the chief forester, he must ensure a uniform procedure for the development of multiple use plans for those ranger districts within his region that have similar characteristics. "The object of these guides is to equip the district ranger with criteria upon which he can base coordinated management decisions for the land-use problems of his ranger district" (Cliff, op.cit.). At this level there is the introduction of data pertaining to the potential of each resource, and demands that are likely to be made upon it.

3. Preparation of ranger district multiple use plans. Here the management decisions from above are amalgamated with qualitative and quantitative data of local (i.e. district) resource conditions. The ranger district is really the working unit in the implementation of multiple use plans. As the policies, guidelines and plans descend the hierarchy there is an increasing reflection of conditions, of people and resources of the district. The delegation of responsibility to the field forester was inaugurated very soon after Pinchot was made head of the Forest Service, and has proved an effective way of allowing decisions to be made as near the scene of action as possible (Pinchot, op.cit.).

For all the direction from above and technical knowledge at his disposal, the district ranger is the keyman in the implementation of multiple use. Where conflicts arise between resources or uses of a resource, the ranger is ultimately dependent on his own discretion in the determination of the optimum combination of products from his district. That the legal definition of multiple use is of little help has been shown. Technical criteria have until very recently reflected financial and ecological values. Since the ranger is a trained forester it was not unusual for forest production to be given preference in the resolution of conflicts.

To date, dependence on ranger discretion has borne adequate results, but the procedure of relying upon an individual's intuitive interpretation of policy statements make possible the injection of conscious and unconscious biases that could deny the achievement of maximum public welfare. Several authors have commented on this situation.

Reich (1962) pointed out that there were few, if any, safeguards to ensure that public wishes would determine operating decisions:

> "the power of the Forest Service is awesome ... it recognizes in the matter-of-fact pages of its manual that its ultimate job is nothing less than the definition of the 'public good,' a task once reserved for philosopher-kings. This is the tremendous responsibility that Congress has delegated to all the forest agencies and with it the power to determine the very character of the American people."

Hall (op.cit.) was a little more cynical. "Forest management, like war, is too important a task to be left strictly to individuals however competent and dedicated." Allowing decisions to be made locally may ensure recognition of local wishes but also carries the potential of bending national objectives in the face of politically powerful local interests (McConnell, 1959).

Forest Service policy is "multiple use," and although it has an enviable record of satisfying a wide range of social demands from the resources of the national forests, the present dependency upon personal discretion is not without risk. Conspicuously absent from the directives that a ranger receives is a definition of public welfare, and criteria for selecting the management plan that will result in the optimum combination of goods and services.

Much of the Forest Service's success can be attributed to the calibre and training of its district rangers, but other factors are of equal importance. Firstly, the Forest Service is the only agency that has jurisdiction over the whole resource base of the national forests. A single management agency with defined goals is a key factor in implementing multiple use or integrated resource management. This means that although Forest Service policy is not succinct, interpretation of plans and resolution of conflicting demands can be made in accordance with a single management goal.

The second point to note is that the area over which the Forest Service has charge is clearly defined. This definition of area means that surveys and inventories can be made, and upon examination of the results it is possible

to assess the extent to which demands can be met. When multiple use is proposed for an indeterminate area, it is impossible to define resource potential, or demands.

The third and most important point is that the Forest Service is able to define the populations for whom the resources of the forests are being managed. Although the reconciliation of national and local interests is seldom easy, definition of a population enables the identification of demands. Without this recognition of demands, management goals cannot effectively be achieved.

Thus the United States Forest Service is more or less satisfying the prerequisites of integrated resource management: viz. it recognizes social needs of referrent groups; the area of management is defined and a single administrative agency is responsible for reconciling specific demands and supplies.

WATERSHEDS AND DRAINAGE BASINS AS UNITS FOR INTEGRATED RESOURCE MANAGEMENT

The many varied properties of water make it vital to human existence, yet it is probably one of the most abused resources in North America (Udall, 1968). Not only is water lost to use through pollution, but also through sub-optimal use that is a result of lack of cooperation between the many interests vested in each of the phases of water properties.

Pioneers to this continent were able to satisfy their water requirements directly from stream and lake. Water belonged to everyone and so was no one's responsibility. As communities grew, householders' functions concerning water shifted to public bodies. These responsibilities have often outgrown local agencies and so they have been passed from hand to hand until in many cases federal aid had to be sought. Several reasons can be identified to explain the ultimate dependence of national government support. These include:

1. In line with economic thinking and free enterprise, private bodies were able to play an important role in developing various aspects of water resources, particularly those where profits seemed likely. However, the market system has not ensured that even distribution of benefits it claimed to be capable of. It was inevitable that government has had to step in to attempt some form of coordination of water-based enterprises to protect the consumer.

2. The scale of operations required for river control even on a local basis was often beyond the financial and legal scope of local authorities.

3. Recognition of the value of multipurpose projects (e.g. the Hoover Dam) and that for maximum benefits, a river should be considered for development in its entirety, were steps in the direction of comprehensive river development. However, where such was contemplated, often a number of federal states were involved, each with different requirements of the same water. Conflicts resulted. Seldom have states been able or willing to compromise and cooperate of their own free will, and federal coordination became necessary.

Watersheds and drainage basins have received favourable attention as specified areas for resource management in general, and coordination of water uses and users in particular. Their geographic limits allow recognition of populations and needs. The ubiquity of water and its properties and uses should promote a central agency that is capable of focusing attention on numerous projects of varied natures. Thus it is tempting to propose that such physical units be adopted as specified areas for integrated resource management. While the definition of basin and population is possible, the establishment of an agency responsible for planning and implementing coordinated resource programs appears to be almost impossible under present

social and political conditions. The Tennessee Valley Authority, incorporated at the beginning of the depression years, is the only agency in North America specifically charged with, and empowered to bring about, "the economic and social well-being of the people living in the (Tennessee) river basin" (T.V.A. Act 1933, section 23) i.e. to satisfy the previous conditions deemed necessary for integrated resource management, using a drainage basin as a specified area. The Authority's establishment, survival and degree of success are attributable to unique circumstances that are not likely to be repeated (McKinley, 1950).

There are several reasons why drainage basins are rarely well suited for consideration as units for integrated resource management. For instance:

1. Present demands for natural resources allow few areas to live in splendid isolation. Local and national populations are interdependent for a varying number of daily essentials--one being water. It is becoming ever more feasible to divert large quantities of water from one basin to another, e.g. New York City is allowed to withdraw 800 million gallons per day from the Delaware River Basin (see part four of this chapter). The degree of interdependence of local and national interests reflects the size of the local population and the size of the basin--the smaller either of these two characteristics, the less chance such a basin has for being considered as a planning unit.

2. When the criteria of the area's development shift from a hydrologic focus, the basin or watershed loses relevance as a planning unit. For example, hydroelectricity distribution or recreation require different areas for planning than that afforded by a drainage basin (Knetsch and Hart, 1961).

3. Basins seldom fit into existing patterns of geographic or functional government administration. Hence consideration of a basin as an administration unit means that the establishment of the basin's governing body must overcome the natural opposition of entrenched jurisdiction.

The more comprehensive the planning for river development, the more will the other resources of the basin be encompassed. The primary objectives in the rehabilitation of the Tennessee Valley were water oriented, but as the immediate problems of river control were solved, the program was expanded to include soil conservation, agriculture and forestry programs, to prevent deterioration of water properties in the headwaters of tributaries and watersheds far removed from the influence of dams on major streams. With the river system controlled programs of a more social nature were entertained by the T.V.A.

It is proposed to mention two examples of American river basin administration. The Tennessee Valley, as mentioned, is unique but illustrates what can be achieved for a referrent group by a single coordinating agency. The second example is the Delaware River Basin. From the study that was made of this region, it is possible to understand how the recommendations made for basin administration (primarily for the coordination of water uses) were reached in the light of present social, economic and political situations.

THE TENNESSEE VALLEY AUTHORITY

The information upon which the following discussion is based was obtained from Smith (1966), Lilienthal (1953), and Martin et al (1960).

The Tennessee River had a reputation of serious flooding and navigation difficulties that was known to the native Indians. White settlers initiated a system of levees to protect their townships, but otherwise no river control work was implemented until this century. To add to the region's problems, the land bearing these settlements had become impoverished through ecologically unsuited agricultural practices. Crops such as tobacco and cotton had not only lowered fertility levels but had also resulted in massive losses of topsoil by erosion. Consequently, at the beginning of this century, there was desperate need for river control work and cheap fertilizers.

By this time, the Tennessee's potential for producing hydroelectric power was becoming apparent, and cheap electrical energy was a prerequisite for the conversion of atmospheric nitrogen to nitrates. The First World War was the vehicle whereby industry capable of such conversion was proposed--munitions were to be produced first and after the war, fertilizers. In 1917 the War Department contracted out the construction of several nitrate plants that were to use privately produced power initially and, later, to use power from a government sponsored dam (to become known as the Wilson Dam) to be constructed at Muscle Shoals (a section of the river in Northern Alabama). Although the nitrate plants were completed they were not put into action because the end of the war was imminent: funds for the government's dam ran out before construction was completed. The Government attempted to lease the Muscle Shoals project to private developers but without success, and from this time until the incorporation of the Valley Authority, controversy continued over the issue of private or public development.

Interest, which was to become national in extent, quickened when Henry Ford submitted a bid for the project. Between 1921 and 1924 the political wrangling became intense, with Senator George Norris seeking to prevent any development by private interests and pushing for federal aid for public development. According to Smith (op.cit.) Ford was the first to see the river and its environs as a single unit for economic development; there was talk of a complete navigation system, agricultural programs and new industries. Ford inexplicably withdrew his offer in 1924, but many of the above points were incorporated into Norris' proposals.

Not until 1933, the early months of President F. D. Roosevelt's term of office, was real progress made. By this time, the Tennessee Valley was one of the most poverty-stricken of all the major river basins of the country,

and this stirred Roosevelt to propose measures that went beyond Norris' hopes and expectations. In a message to Congress early in 1933 Roosevelt stated:

> "It is clear that the Muscle Shoals development is but a small part of the potential public usefulness of the entire Tennessee River. Such use, if envisioned in its entirety, transcends mere power development: it enters the wide fields of flood control, soil erosion, afforestation, elimination from agricultural use of marginal lands, and distribution and diversification of industry. In short, this power development of war days leads logically to national planning for a complete river watershed involving many States and the future lives and welfare of millions. It touches and gives life to all forms of human concerns.
>
> "I, therefore, suggest to the Congress legislation to create a Tennessee Valley Authority--a corporation clothed with the power of government but possessed of the flexibility and initiative of a private enterprise. It should be charged with the broadest duty of planning for the proper use, conservation and development of the natural resources of the Tennessee River drainage basin and its adjoining territory for the general social and economic welfare of the nation. This Authority should also be clothed with the necessary power to carry these plans into effect. Its duty would be the rehabilitation of the Muscle Shoals development and the coordination of it with the wider plan." (quoted in Smith, op.cit.)

A bill was passed by Congress in May that same year legally incorporating the Tennessee Valley Authority. In Section 23 of the Act, the Authority was charged with the purposes of bringing about:

"1. the maximum amount of flood control;

2. the maximum development of said Tennessee River for navigation purposes;

3. the maximum generation of electric power consistent with flood control and navigation;

4. the proper use of marginal lands;

5. the proper method of reforestation of all lands in said drainage basin suitable for reforestation; and

6. the economic and social well-being of the people living in said river basin." (U.S. 48 Stat. 58)

According to the Act the Authority was to be guided by a board of three directors appointed by the President, one being appointed Chairman.

The first board of directors divided the work among them so that each was able to remain in the field in which he was known. A. E. Morgan (the board's first chairman) took control of the construction projects, and also made them instruments for training local manpower in building skills. H. A. Morgan supervised the fertilizer and agricultural programs. He turned to the land-grant colleges for assistance thereby forging a link between the suspicious conservative elements of the Valley, and the new untried government agency. D. Lilienthal accepted the responsibility of organizing and operating the Valley's power system and seeing to the legal affairs.

Although such a division of labour seemed logical, it soon became apparent that it was not promoting the cohesive action that was required. The situation was not improved by the personal relationship between the chairman and the other board members. Consequently the board was not as effective as it might have been in coordinating the work delegated to the numerous federal, state, local and private enterprises. Roosevelt removed the chairman in 1937, and the following year the directors made a decision under which the Authority has progressed more effectively. It was decided that the board members should withdraw from direct supervision and devote their energies to policy formulation and a more general approach to program supervision. The creation of a general manager's position provided the link between the board and the administrative organization with the responsibility of program execution.

The effectiveness of the Authority's structure in achieving its objectives can be judged from the following facts. A total of thirty-one dams has been constructed and since the control system was put into effect there has not been a major flood. The average annual savings from flood damage has been estimated at thirteen million dollars, (T.V.A. Facts, 1961). From the beginning the Authority recognized the importance of land use to

water quality and regime, and forestation programs were established in numerous watersheds. Navigation improvements over more than 650 miles of the River have resulted in an increase of river traffic from 33 million ton-miles in 1933, to two billion ton-miles in 1961 (T.V.A. Facts, op.cit.).

With some reservations, the Authority has been similarly effective in promoting the production of electric power. Some steam generating plants were in use before 1933, and from its inception, the Authority had control of these as well as hydro plants upon which it concentrated, since such power generation was closely connected with the development of the river system in general. The Second World War saw increased demands for power for military purposes, and to meet the challenge the Authority turned its attention to the construction of more steam plants. By 1961 the Valley boasted thirty-one hydroelectric and twenty steam plants, with an impressive total of kilowatt-hour production. After the war munitions factories took on a more peaceful purpose, and for regional economic prosperity yet more industry was attracted to the Valley by sources of cheap power. The nature of the Valley's coal deposits and the demand for coal made by the steam plants resulted in extensive strip-mining operations. The Valley Authority, however, has turned a blind eye to the single-minded fashion in which the mining has been carried out, and which has resulted in devastation of other resources which, during the war years, were of little apparent importance. The heavy industry of the area is also responsible for considerable quantities of atmospheric pollution. Fortunately there is a growing awareness of these effects upon the environment and steps toward rehabilitation and reclamation are being taken.

Around the Muscle Shoals nitrate plant has sprung up a renowned fertilizer research program, designed for testing and developing new fertilizers. Not

seeking to compete with existing industry, the Authority has maintained a policy of allowing all their fertilizers to become public patents. Any private company can obtain without charge a license to produce a new fertilizer and as soon as the new product attains commercial recognition, the Authority ceases its own production. Test and demonstration farms have been sponsored by the Authority with a view to inducing better farm management practices.

Although not specifically mentioned in its terms of reference, the Authority has accommodated demands for water-based recreation. Demonstration parks were initiated on reservoir shorelines in 1934. Since 1945 the demand for such facilities has increased dramatically and miles of additional shoreline have been made available. While not operating these services itself the Authority has donated the facilities to state and local recreation authorities.

As a further example of the Authority's implication in the region's welfare, there has not been a single case of malaria traceable to the river for many years--and this in a region where the disease is endemic and was previously widespread. The success of such health programs is attributable to the degree of cooperation between the Authority and state and local health organizations.

A comparison of average individual incomes of the Tennessee Valley indicates the effectiveness of the Authority in alleviating general poverty. In 1933 the average individual income in the state of Tennessee was 45 per cent of the national average; in 1966 it was 68 per cent. Corresponding figures for South and East Kentucky, outside the Tennessee Valley, are 36 and 39 per cent respectively (Smith, op.cit.).

There are a number of important features of the Authority that help to account for its success:

1. The Authority is a federal organ, yet completely separate from all other existing federal departments. It therefore enjoys substantial administrative independence and autonomy.

2. It is also a regional agency, bringing federal authority to bear on the problems of a specific area. The maintenance of the Authority's headquarters in the Valley, and not in Washington, ensures better communication with local people and problems.

3. The requirements for integrated resource management are not specifically mentioned in the Authority's terms of reference, but were implied in Section 23 of the Act (page 77). Even when the initial work with a single resource was being put in hand, recognition was given to adjacent resources so that as far as possible, completion of one project would not result in more problems. As the main objectives were achieved, others of a less spectacular nature were dealt with in a similar coordinated manner. It is difficult to account for the Authority's toleration of industrial air pollution and the side effects of strip mining.

4. The Authority did not attempt to set itself up as a "super power," usurping the authority of local organizations. Instead the board chose to work within existing governmental frameworks and play the role of advisor (and to carry out research upon which to base advice) to existing administrative structures.

As previously mentioned, the conditions under which the Authority was incorporated, i.e. the abundance of all levels of labour and technical assistance made available by the depression, and the political and social climate of the times, are not likely to be repeated. However, in a considerable amount of literature dealing with planning and resource development, the

success of the Tennessee Valley Authority is often pointed to. Suggestions and recommendations have been made to the effect that other of the nation's large drainage basins should be similarly administered, but to date no other "authority" has ever been incorporated. Lilienthal, who was involved from the earliest days of the Authority's existence, commented on this point:

> "That such an experiment (in decentralization of federal powers) would meet with the combined opposition of an alliance of the Washington Bureaucracy was a fore-gone conclusion ... For if the T.V.A. experiment were ever repeated in essentials in other regions one after another, the power and influence of the Washington Departments--from cabinet officers down--would be immeasurably decreased. No centralized authority in the history of the world has ever submitted to such defeat without a long and bitter fight." (Lilienthal, op.cit.)

Without doubt, this sums up the reasons why similar administrations have not been incorporated in river basins elsewhere, although the need has been demonstrated.

The three essential points for integrated resource management that were made earlier can be identified in the effectiveness of the work of the Tennessee Valley Authority, as they were for the Forest Service. The physical boundaries of the drainage basin delineate a resource base that furnishes the supply for the demands of the population that is similarly defined. The Valley Authority is the single agency that has the responsibility of planning the optimum outcome of supply and demand, and the power of implementing coordinated execution of the plans.

THE DELAWARE RIVER BASIN

The Delaware River Basin, like the Tennessee Valley, is an interstate system, including various proportions of the states of New York, New Jersey, Pennsylvania and Delaware, and has a history of political controversy of equal intensity and probably more complexity. Over the years there have

been studies, surveys, commissions, advisory councils, etc., making different proposals for the development of the basin's water resources. None have been implemented in full, and a few gained no support at all. This section is based upon a recent report of a group of people from Syracuse University, viz. Martin, Birkhead, Burkhead and Munger, whose report was published in 1960.

The agencies interested in the basin's water resources presently number approximately 250--most are public but a few are private. Around each function or use of the river a separate public has tended to emerge, and in line with modern social attitudes and political thinking each has sought survival and prosperity through the achievement of as much autonomy as possible. The larger issues occupying most of these groups include the allocation of water supply, flood control, pollution abatement (necessitated by the use of the river for disposal of domestic sewage and mine discharge), as well as navigation and hydroelectric power production and more recently, water oriented recreation.

Until the late 1950s there was a paucity of collaboration between these separate publics, and it might be surmised that the resultant inefficiency in the river's development would have seriously affected the region's economy. Such has not been the case. In contrast to the Tennessee Valley, where lack of development caused poverty levels that provoked federal intervention, the Delaware Service Area "has a wealthy population and a mature economy. The main economic concern at present is to maintain parity of growth rather than accomplish rapid development" (Martin et al, op.cit.)

In 1960 the population of the basin was roughly six million people. By a decree of the United States Supreme Court in 1933, New York City, which lies outside the Delaware River Basin, was granted approval for the withdrawal of 800 million gallons per day from the River's head-waters, thereby adding

another 11 million people to those already directly interested in the river. New Jersey is similarly allowed to divert 100 million gallons per day. Thus the water resources of the basin are "fundamental to the economic and social well-being of some 21 million people." (ibid.)

Comprehensive basin-wide development was proposed as early as the 1920s --it is an idea that has waxed and waned with changing times. The year 1936 saw the establishment of Incodel (Interstate Commission on the Delaware River Basin), that proposed the idea of voluntary interstate cooperation, but without result. As the magnitude of the problems grew, acceptance of the principle of basin-wide administration grew. In 1955 two hurricanes struck the northeastern parts of America within three days of one another and caused the Delaware River to flood to such an extent that a hundred lives were lost and millions of dollars worth of damage was done. This catastrophe made the issue of the region's development a critical one. The Corps of Engineers began a brand new survey, disregarding all past efforts and adopting a "broad view of the basin's water resources" (ibid.). Like previous efforts it stimulated some support, but the dissolution of the survey staff was the demise of this interest. Two years later the river carried such small amounts of water that domestic supplies were endangered and interest was once again revived.

From informal meetings of the governors of the four states and the mayors of New York City and Philadelphia, the Delaware River Basin Advisory Council (DRBAC) was formed to examine problems of regional administration of water resources. The Council recommended that a Ford Foundation grant be made available to Delaware River Basin Research Inc., a research agency that was created for the purpose of administering these funds. This agency in turn entered into a contract with a research group at Syracuse University (headed by R. C. Martin) to carry out the necessary research. The resulting

report entitled "River Basin Administration and the Delaware" was published in 1960. It is an extremely thorough work dealing with all aspects of regional administration in general, with specific reference to the Delaware.

In attempting to discover the best administration for the particular needs of the Delaware Basin, the authors of this study bound themselves to the maxim that "form follows function" i.e. the best type of administration for any particular situation is the one that fits closest the requirements set by a prospective program. With this general aim, the authors developed ten criteria with which to evaluate the adequacy of administrative mechanisms. These criteria are not limited to the context of the Delaware Basin or water resources and constitute very pertinent questions that can be asked of any administration--not the least of which might involve integrated resource management. They will be briefly outlined here.

1. Congruity of Area and Function. This concerns the compatability of the function (program) to be administered and the area responsible for it. Incongruity exists (a) when a function outgrows a government to which it has been long assigned, and (b) when a new function arises which requires administration not presently available.

2. Population Base. The size of the population is important with respect to such matters as consumer demand and need for services, capacity to support services, vigour and variety of citizen participation and the provision of a source of civic leadership. Up to a point, larger government (reflecting a larger population base) is more efficient than small.

3. Program Scope and Depth. A program that is insignificant in making substantial differences to people, that does not command popular interest and technical competence, cannot lay claim to being effective or completely necessary. "A unit of government which performs no important function or

which is ineffectual in what it undertakes is worse than a useless thing for it tends to subject all government to popular suspicion and even ridicule" (ibid.).

4. Legal Authorization. Trite as it may sound, a government without the power to discharge the function for which it was created, is of course useless. "The American government is filled with the chronicles of units which, created in moments of high purpose (or desperation) failed to get off the ground for want of legal authority commensurate with their assigned tasks" (ibid.).

5. Financial Resources. Fiscal adequacy is as important as legal authorization in the realization of objectives.

6. Accountability. (a) There must be internal attention at all levels of governmental structure. Failure to revise structure to comply with changing needs can quickly lead to inefficiency. (b) Government should continually be aware of how well policy formulation, direction and control reflect the will of the people.

7. Flexibility. Administrative structures must be capable of recognizing and adapting to changing needs. Being tied exclusively to a particular program, and/or inflexible legal boundaries, is a sure way to prevent consideration of needs growing from related development.

8. Structural Compatibility.

> "The federal system though formal, complex and deliberate, is a fundamental feature of American government. The challenge is not to undermine or circumvent federation but to achieve a working order within the framework which it provides ... Thousands of small and seemingly inefficient government units exist, measurably reducing the effectiveness of the total public enterprize through competition for financial support and citizen attention.
>
> "At the same time care should be exercised in the creation of a new government unit which, however justified in programmatic terms, must be considered with reference to potential effects on its pro-

spective relations with existing governments. This is a subtle but significant point, for responsible action requires that due consideration be given to all relevant factors including specifically the interests and concerns of existing government units before moving to the establishment of a new government or administrative area" (ibid.).

9. Contemporariness. Ability to maintain flexibility, legal and financial status and to adapt to demands continually is a requisite for efficient government.

10. Political Viability. Political strength is required to gain initial acceptance and later to ensure survival. New units must be capable of fighting and winning the battle of popular resistance to change and against entrenched interests, and be prepared to fight for survival.

The authors of the report reached three main conclusions:

1. Within the Delaware Basin significant water resources were being poorly administered or ignored completely;

2. Existing government machinery was not adequate for important changing needs; and

3. An administrative agency with jurisdiction throughout the Basin promised the most logical solution to regional aspects of the water resources problems.

By examining the needs of the region, and applying the criteria for effective administration (i.e. by examining both function and form) the authors were able to propose a type of administration that could meet the specific requirements. A case could be made for applying a Federal statute, or designing an interstate compact; the former would be more expeditious while the latter would enable the states to play fuller roles in the Basin's water development. It was eventually decided that both tactics could be usefully employed. To this end a "two phase" plan was recommended. Briefly, this would take the following form:

Phase One: The establishment by Congressional Statute of the Delaware River Agency for Water (DRAW). The policy-making arm of this agency would be a commission composed of federal and state representatives. The substantive powers of the agency would be:

(a) to collect and correlate data related to present and potential uses of water;

(b) to prepare and continuously revise and supplement a comprehensive plan for the development of water and water related resources of the basin. The proposed scope of the commission's plans was outlined here, for after naming flood control, water supply, pollution control and development and distribution of power supplies, mention was made of recreation, fish and wildlife preservation, watershed management, soil conservation, forestry, irrigation, drainage, stabilization of stream banks and related development of water resources. The thoroughness of the planning showed that the authors were indeed cognizant of the fact that the Basin's need of development was for more than water control, and that if the river system was to be effectively developed as a unit, consideration of other resources could not be omitted;

(c) to design integrated planning operations for flood control, water supply, power production and other related facilities;

(d) to protect and improve water quality in the Basin;

(e) to represent Basin interests before government agencies, private groups, etc.;

(f) to promote coordination of the activities of all public and private groups that have interests in the Delaware's waters;

(g) to exercise powers conferred by state and federal law;

(h) to conduct public hearings for operating plans of all water resources; and

(i) to make suitable preparation for the transfer of all facilities to the Delaware River Commission upon the creation of the body.

Similarly comprehensive proposals were made regarding the financial powers of DRAW.

Phase Two. Here was the establishment of an agency by federal-interstate compact to be known as the Delaware River Commission (DRC). Basically this body would have the same functions as outlined above for DRAW. The main difference between the two agencies was that the DRC had greater state representation--a move to soothe those troubled by "anti-federal" feelings, and to bring about a more efficient mechanism for solving local problems. Another reason for choosing the two-phase approach was that, based on past experience, it was anticipated that an excessive amount of time might elapse before such a compact would gain approval. The federal statute was proposed so that the expected time lapse could be used to prepare the ground work for the Commission; if not used, the period of inactivity would probably negate the report's objectives.

Martin (1963) told of the importance of a broad-based public education program that had been sponsored and maintained by the Delaware River Basin Research Inc. between 1957 and 1959--the date when the Syracuse report reached the DRBAC. Consequently there was a climate favourable to action and it was decided to proceed directly to Phase Two of the report's recommendations. Approval for the federal-interstate compact was secured and finalized by the President's signature in 1961. Thus the Delaware River Basin Commission was formed, consisting of the governors of the four states and a fifth commissioner appointed by the President. Its powers are broad within the domain of water resource management but are so cast as to avoid exerting an unfavourable influence on any existing program. "The central power is that granted to the

commission to devise a comprehensive plan to govern the water resources of the basin, and to review with power to disallow or require modification of all future proposals for projects substantially affecting water use." (Martin, 1963) The compact is unique in that the federal government is a party to and signatory of an interstate relationship. The rapidity and willingness which the states exercised in accepting proposals for the compact are also worthy of note.

By 1963 the Commission had progressed into the problems common to all new agencies, i.e. acquiring headquarters (in New Jersey), recruiting staff, delineating tasks and negotiating a budget. Other problems of a less mundane nature remain, perhaps the most crucial of which will be those of a "public versus private" nature--the decisions of the Commission in such a situation are open to prediction.

From an administrative point of view the problems of the Delaware Basin involved (a) primarily a single resource, (b) public and private interests, and (c) a general awareness of the need for coordinated action. The difficulties encountered in the reconciliation of these points have been solely of a political nature. Never once were the technical problems involved in managing the river system as a unit considered insuperable or prohibitive to cooperative basin administration. (The same is true of the background of the Tennessee Valley Authority.) This is not to say that technical problems do not exist. They do--in the form of the physical effects of the exploitation of one resource upon another, and in the difficulties encountered in the quantification and evaluation of natural resources.

Cooperation among the Delaware Basin states was only achieved in an atmosphere of widespread, favourable public interest. To attempt the imposition of integrated resource management where public interest for such is lacking,

is an exercise in futility--a point overlooked by many who indiscriminately propose the ideas and principles of "multiple use."

CANADA: ONTARIO'S CONSERVATION AUTHORITIES

For the reasons given in Chapter V, Canada has had little demand for integrated resource management. However, the Conservation Authorities of Ontario illustrate some of the objectives of this thesis in a Canadian context.

The unit of jurisdiction of each authority is a watershed, (defined as "an area drained by a river and its tributaries" (Conservation Authorities' Act, 1946)). In 1965 there were thirty-four such authorities in existence (Ontario's Department of Energy and Resources Management, 1965), the majority of which were to be found in the rich agricultural lands in the south of the province. Because of their agricultural suitability, these were the areas first taken up by the settlers, and today a considerable proportion are in private hands, and most are under intense management of some form or another. Wild-land resources are not therefore of great importance. Nevertheless, it has been found necessary to promote various conservation projects, and although coordination of the activities within a watershed is not a specified goal, it has become obvious that "schemes" must be carried out with at least some regard for other resources. (A "scheme" is defined as a project "undertaken by an authority for the purposes of conservation, restoration and development of natural resources other than gas, oil, coal and minerals, and the control of water in order to prevent floods and pollution, or for any other purposes" (Conservation Authorities Act, 1946)). In watersheds, as small as those in Southern Ontario, having relatively large populations, the interaction of one scheme with other resources is likely to be considerable.

As pointed out by Richardson and McMullen (1961), the reason for the institution of the Conservation Authorities was not that there were no other

government departments concerned with natural resources. Like other provincial governments, Ontario has its departments of Lands and Forests, Agriculture, Public Works, etc. Why Ontario should establish another agency to handle conservation projects is not immediately clear. The above authors merely state " ... (it) was an entirely new approach in conservation activities directed to assist the municipalities primarily in Southern Ontario."

The Conservation Branch of Ontario's Department of Planning and Development was established in 1944 and was charged with organizing conservation work using watersheds (i.e. drainage basins) as units of administration. From the terms of the 1944 Act and the scope of the work envisioned, it became obvious that there was to be close liaison between the municipalities within the watersheds and the Department. The Conservation Authorities Act of 1946 was apparently passed to encourage greater local participation in conservation projects. All the municipalities within the watershed--cities, towns, villages, etc.--became included in the body corporate.

Richardson and McMullen (op.cit.) explained the establishment of a Conservation Authority:

> "The first step in establishing a Conservation Authority is undertaken by all the municipalities wholly or partly within a watershed. Two such municipalities must first by resolution petition the Minister of Commerce and Development to call a meeting for the purpose of ascertaining whether or not it is desirable that an Authority should be established. Two-thirds of the number of representatives which the municipalities are entitled to appoint (on a population basis) must be present to make the meeting legal. If two-thirds of those present vote in favor, a resolution is forwarded to the Minister requesting that an Authority be established. The Authority is then made legal by an Order-in-Council and under the Act becomes a body corporate with members from all the municipalities in the watershed, including those, if any, which voted against its establishment.
>
> "The establishment of a Conservation Authority is a simple legal matter. At the preliminary meeting the presiding officer is a senior civil servant who, together with a secretary chosen at the meeting, forwards a report with the resolution to the Minister

> of the Crown. In some cases small adjustments have been made in the area under consideration before the Order-in-Council was presented for approval, but since the inception of the work not one request for establishing an Authority has been refused."

The Ganaraska Authority, one of the first to be formed, had as its main goal "the reforestation and maintenance of forest land" (Porter, 1948). This objective has since proved to be unique in that most authorities have come into existence in response to the need to alleviate flooding. There has been a general awareness of the requirement for supplementary measures such as improved methods of land use, protection of headwaters, prevention of pollution, etc., but these appear to have played very minor roles in comparison to more direct methods of resolving the problem.

Few authorities are equipped to carry out the thorough surveys and investigations that would indicate where management might best apply itself in meeting its terms of reference. Thus the Conservation Branch agreed to carry out such work, and to produce and hand over to the Authority the results in the form of a working plan, known as a Conservation Report. These reports are generally very thorough in their dealings with the various aspects of resources within a watershed. The contents are written up under six main headings:

1. History - the object here is to give a localised picture of the area's past development, including historic and social events, in an attempt to generate interest and support for later recommendations;

2. Water Studies - include hydrometric and meteorologic studies of past data;

3. Land Use - considerable use is made of the provincial soil surveys that have been undertaken since 1937, to gain an impression of the interrelationships of soil, agriculture, forestry and water;

4. Forestry - the conditions and extent of the forests are surveyed as well as levels and potentials of forest industries;

5. Wildlife - inventories are made of all species of fish and game, and their recreational potential determined;

6. Recreation - human population pressures are examined and predicted as well as the recreational potential of the watershed in terms of present and future facilities.

On the basis of such investigations, the Conservation Branch makes recommendations as to how demands can best be met within the physical limitations and biological constraints set by the watershed's resources. The report is then presented to the authority whose responsibility it is to determine a list of priorities and the order in which schemes should be implemented.

Authorities may see fit to appoint an "Advisory Board," which in some cases has proved to be the most active part of the authority. The membership of this board is not limited to authority personnel, but provides an opportunity for private individuals and groups to participate in a "grass roots" approach to local affairs. Such participation is the best way of promoting and sustaining awareness and concern for the resources of a region such as a watershed. Whereas most of the work of an advisory board is in the preliminary stages of implementation, final decisions are reserved to the authority.

The implementation of conservation projects is entirely the responsibility of the individual authority. Each authority has the power to expropriate land, and also it may "collaborate with departments and agencies of the government, municipal councils and local boards and other organizations" (Conservation

Authorities Act, 1946). The financial arrangements of an authority are listed in the Act under the headings of capital expenses, maintenance on capital costs and administration costs. These costs are borne through a combination of payments by the benefiting municipalities, provincial assistance, private payments and, in some instances, federal grants.

While the Conservation Act does not mention coordination of the whole resource complex of a watershed, several writers have deemed that such an approach is implied, or made possible. Higgs (1964) quoted Dr. R. C. Wallace who at the time of the establishment of the Ganaraska Conservation Authority wrote:

> "Conservation is apt to be interpreted as either soil restoration or reforestation, but what is really involved (in the work of an authority) is the survey of all resources leading to multiple purpose rehabilitation. It is now recognized that programmes should extend to a whole region."

Higgs himself stated that "the legislation (of the conservation authorities) is sufficiently comprehensive to provide the authorities with an opportunity to develop a complete programme for the management of natural resources on a watershed basis" (Higgs, op. cit.).

Although the potential of resource integration has been recognized, the fundamental goal of resource management has not been stated. The objective of integrated resource management as defined in this thesis is the achievement of maximum public welfare, but this does not appear to be the case with Ontario's conservation authorities. In fact many schemes would seem at first sight to benefit private individuals only, e.g. assistance to individuals for the construction of farm ponds, the planting of shelter-belts and the laying of tile-drains, etc.

In theory the concept of local agencies with the power of concentrating local and provincial money and effort on local problems is sound. Political

machinery that allows the participation of people in conservation problems that directly concern them should be successful in outcome. In practice the conservation authorities have not been as successful as they might have been. The reasons for this are of a political nature.

On the one hand there appears to be significant duplication of responsibility in some areas between the conservation authorities and the provincial departments concerned with specific resources. This, as is so often the case, has led to professional jealousies and competition between agencies; accomplishment of the project assumes a secondary role to the outcome of the prestiges of those involved. Consequently, in its relations with other provincial departments, the conservation authorities have become something of a political football. Originally the authorities were a branch of the Department of Planning and Development which became the Department of Commerce and Development in 1961. From then until 1964 the authorities were under the jurisdiction of the Department of Lands and Forests, and since 1964 they have been with the Department of Energy and Resource Management.

On the other hand the authorities have had to face problems involved with private vested interests. As previously stated, the watersheds consist largely of land suitable for intensive agriculture, which has become the established use. The impression is gained that conservation schemes can be proposed and implemented as long as private parties are not called upon to sacrifice capital assets in favour of schemes that would be of communal benefit. Although authorities have powers of expropriation they seldom receive sufficient support in raising money to meet the going prices for land. Consequently large-scale projects are almost impossible to implement. The situation is exemplified by what is presently happening in the Niagara Peninsula. The northern half of this area is prime agricultural land, extremely well suited to the production

of soft fruit, tobacco and other cash crops. However, both road and sea access make this same area very valuable for industrial development and since industry can afford to pay handsomely for this land, it is rapidly going out of agricultural production. The loss of such land is against some of the basic principles of the Niagara Peninsula Conservation Authority, yet it is powerless to prevent it (Chambers, 1969).

The requirements of integrated resource management, i.e. a specified area, referrent group and single administrating agency are clearly identifiable in Ontario's conservation authorities. Thus one might expect that integrated resource management could be achieved with comparative ease, yet this has not been the case. The reasons can be summed-up as follows:

1. The objective of the conservation authorities has not been stated in terms of maximum public welfare, and although integrated resource management has been considered by some to be the ultimate goal, it has not been at all widely accepted.

2. Most of the land within the watersheds cannot be considered as wild --in fact much of it is intensively managed agricultural land with a relatively long history of settlement. The vested interests that have grown up as a result are well entrenched and not readily amenable to sacrifices for social goals.

3. Although the legislation establishing the authorities gives them considerable powers, vested interests and difficulties encountered in collaborating with neighbouring departments appear to have reduced the effectiveness of the authorities to a level below that which long term planning can be attempted, and integrated resource management implemented.

CONCLUSIONS

The effectiveness of each of the administrative agencies mentioned in the preceding case studies in achieving their objectives can be related to the following points:

1. The purpose for which the agency was established;
2. The scale of operations;
3. The degree of authority held by the agency;
4. The agency's level of fiscal adequacy.

Each of these points is inter-related and cannot be considered without regard to the others.

The first point is equivalent to Martin et. al's (1960) criterion of "program scope and depth," (page 85 of this thesis). Where the situation preceding agency establishment has been of sufficient import to engender widespread and continuing public interest and support, the agency has met with some success in realizing its objectives. This is particularly true for the United States Forest Service and the Tennessee Valley Authority. In these two cases, the severity of conditions, and the scale of activities that were responsible for the creation of administrative agencies, considerably influenced the legal authority and financial support with which the agencies were invested.

In the relatively affluent Delaware River Basin, it was not until the occurrence of phenomena of catastrophic proportions that an interstate compact of any import or potential was developed. Only time will show whether the Delaware River Commission was the result of "moments of high purpose or desperation" (ibid.), or whether it will continue to strive for the integration of water and water-related resources.

The reasons behind the formation of Ontario's Conservation Authorities are of a much less dramatic type, being more related to small-scale conservation, rehabilitation or improvement. These latter reasons for agency establishment are theoretically sound, inasmuch as "prevention is better than cure." However, until the referrent group acknowledges the wisdom of such an approach the amount of support that an authority, attempting small-scale schemes, can expect, will be limited. In turn the authority will be allowed limited power and financial support. Under these conditions there is the possibility that the authority may become "ineffectual, and worse than a useless thing" (ibid).

An agency responsible for attaining the goal of maximized public welfare from the resources of a specified area is crippled without legal authority or financial backing. To this end, the need for integrated resource management must be demonstrated in such a manner and on such a scale, that the sustained interest and support of the referrent group is forthcoming. The imposition of the principles of integrated resource management upon apathy is an exercise in futility.

CHAPTER VII

THE APPLICATION OF SOME TECHNIQUES OF ECONOMICS TO INTEGRATED RESOURCE MANAGEMENT

INTRODUCTION

As the basis of wealth, it is impossible to discuss natural resources and the values that society attaches to them, without some mention of the subject of economics. The use of a money system facilitates the expression of goods and services in common values. Economists, in studying the generation and distribution of wealth, rely heavily on money values for the expression of different resources, products and services in common units.

In recent times society has begun to place increasing importance upon values that do not find expression in the market system. Thus, attempts to analyze problems in integrated resource management using techniques that economists have developed mainly for industrial purposes, cannot be entirely satisfactory. However, a brief look at the principles of some analytical techniques will be helpful in illustrating their advantages and disadvantages with regard to the management of wildland resources.

ECONOMIC OPTIMIZATION

Having defined the referrent group(s), specified area and single management agency, the implementation of integrated resource management hinges on consideration of such points as:

1. What are the specific requirements of the referrent group(s) for each of the available resources?

2. Can these be quantified or evaluated with a common criterion?

3. What are the proportions of each resource that will be required to constitute the optimum combination, taking into account demands and biological constraints of supplies?

The theory of economic optimization can only be applied with complete satisfaction to problems where all the parameters are known, for example, a firm seeking the optimum combination of two products that will result in maximum profits. In this case, the products are known as "rival products" (Duerr, 1960), meaning that in the production process more of one can only be obtained at the expense of the other. The firm has a range of combinations from which it can choose the combination that maximises the net returns from both enterprizes. In reaching a satisfactory decision the firm is said to have "perfect knowledge" (one of the basic assumptions of the free market system) regarding magnitude and value of both supply and demand, capital input, production potential and the proportions of each product that are possible for the achievement of the optimum.

Miller (1961) proposed the concept of certain natural resources as "factors which are produced by nature in both an uncontrolled and controllable state, and then extracted, harvested or harnessed to be used in the preparation of a marketable product through the use of additional inputs of capital and labour to transport and process them". This concept is an economic one and

those resources which may be so classified can have applied to them effectively the otpimization theory of Duerr (op.cit.) and Gregory (1955).

As an example consider the hypothetical case of a land owner who has the opportunity of growing timber or forage, or a combination of both and who wishes to maximize the financial returns from the land. In dealing with only two products, the example can be illustrated graphically.

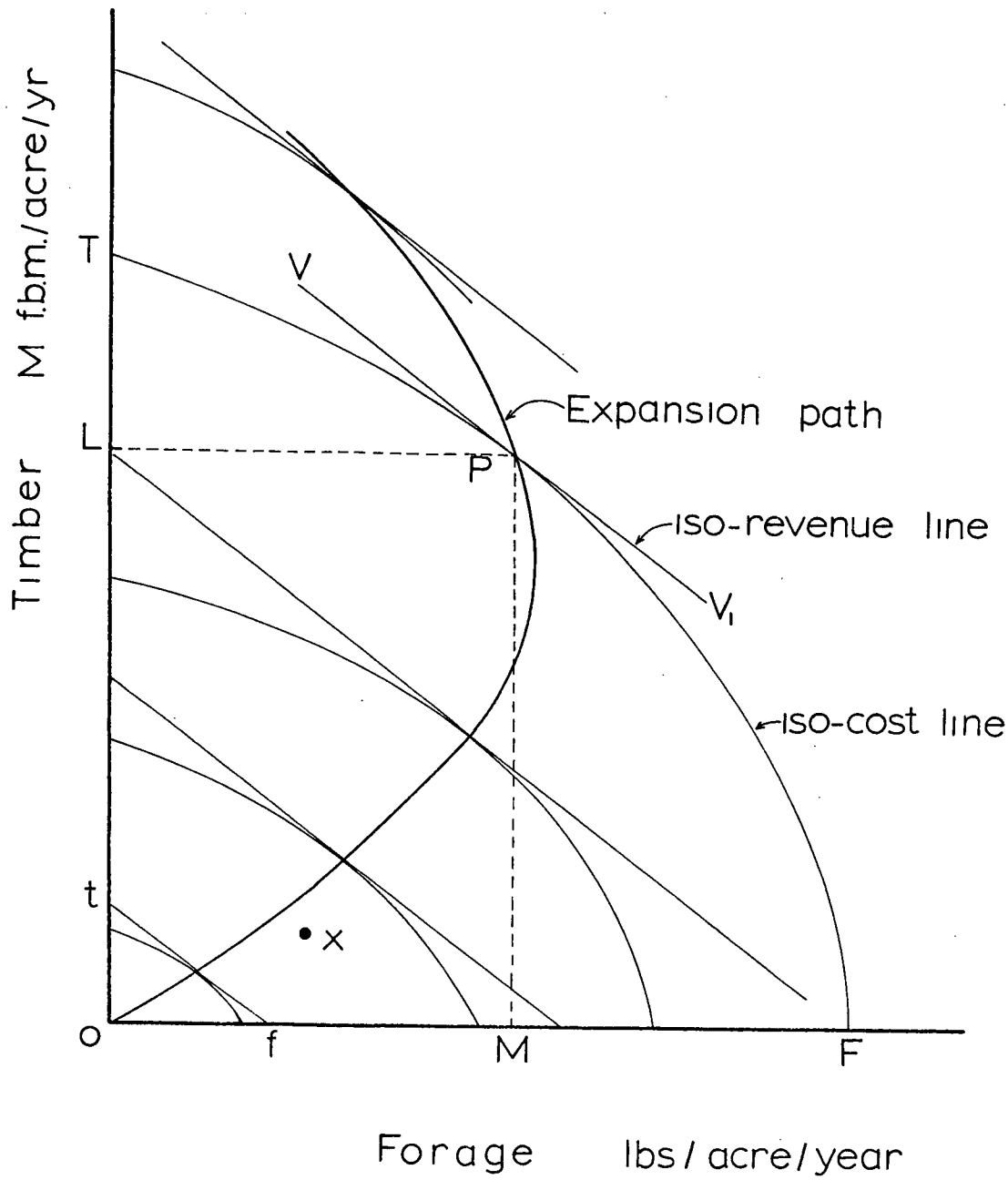
If the land was left unmanaged some combination of forest and grassland would evolve with annual production figures of the magnitude illustrated by point X in Figure 1. We will assume, however, that the owner is willing to incur a cost in order to improve these production figures. We must now also assume that the possible output volumes per acre per unit time of each product, are known for various levels of input.

At a particular level of input or investment, the owner may choose to grow nothing but timber, in which case the volume he can expect to obtain will be T M.f.b.m./acre/annum (Fig. 1). Similarly if he chooses to produce nothing but forage he could expect to produce F lbs./acre/annum. Between these extremes of alternative products is, in theory, an infinite number of combinations of timber and forage that can be produced. These combinations are exemplified by the curve TF which is known as a "transformation function" (Hall, 1964) or an "iso-cost line" (Duerr, ibid.).

The shape of the curve (concave to the origin) is determined by the marginal rate of substitution of one product for the other, and demonstrates the competitive nature of the two products. We will assume that different levels of input will not upset the proportions of each product on the production-possibilities curve (see page 108), but just change the curve's position relative to the graph's origin. Thus we obtain a number, theoretically

FIGURE 1

Iso-cost and Iso-revenue functions of possible combinations of timber and forage



infinite, of iso-cost curves similar in shape to TF and corresponding to various levels of factor input.

The iso-cost curves do not, however, tell the owner the optimum combination of timber and forage. For this he needs to know the value of each product, or at least how much timber is equivalent in value to a quantity of forage, or vice versa.

Assuming that the relationship of the values of the two products is known, (i.e. that x M.f.b.m. of timber is equivalent in value to y lbs. of forage), it may be expressed graphically as a straight line, i.e. tf in Fig. 1. The points on such a line represent different combinations of timber and forage, each combination producing an identical amount of revenue. This line, known as an "iso-revenue line" (Gregory, op.cit.; Duerr, op.cit.), is one of a series of iso-revenue functions each representing a different level of revenue. The line VV_1 in Fig. 1, is iso-revenue function.

Comparison of the slopes of the iso-revenue line and the iso-cost curves allows determination of the best combination on a particular iso-cost line, e.g. referring to TF in Fig. 1, where the slope of TF is less than the slope of VV_1 (i.e. to left of P), the combinations of the two products are indicated in which the value of the extra timber produced is less than the value of forage foregone. The converse holds true for the portion of TF to the right of P. Thus the point of tangency of the two lines indicates that value of each product that contributes to the maximum returns from the land at particular level of investment. In this case these values will be equivalent to OL M.f.b.m. of timber and OM lbs. of forage.

The iso-revenue line is independent of the positions of the iso-cost curves and by comparing the slopes of each of these with that of iso-revenue

line the point of tangency for each curve can be found. The line drawn through these points describes the best output of timber accompanying any output of forage and is generally known as the "expansion path."

The final stage of the analysis is the selection of the best combination of the products from the points along the expansion path. The combination that maximizes returns per unit time is that for which the marginal unit cost equals the marginal unit revenue, or where there is the greatest difference between total cost and total revenue.

Figure 2 illustrates the relationships between the expansion path (as in Fig. 1, but with axes of the graph rotated clockwise through 90°) and the total revenue and total cost curves. It can be seen that the optimum combination of timber and forage that achieves the owner's management goals from all the possibilities at various levels of investment is Q lbs./acre/annum of forage and N M.f.b.m./acre/annum of timber.

The shape of the transformation functions (iso-cost lines) can give some information regarding the relationship of one product to the other. For instance, if the iso-cost lines for two semi-compatible or rival products appeared as in Fig. 3a or 3b, it could be concluded that the two products had a low degree of compatibility. Comparison of the iso-revenue lines to the iso-cost lines would lead to the construction of expansion paths that are close to, in 3a the vertical, and 3b the horizontal, axis. This indicates that the optimum combination consists of very unequal proportions of the two products. As an example consider a shelter-belt of standing timber; if the owner attempts to remove too much of the timber as thinnings, the effectiveness (value) of the shelter-belt is quickly reduced.

Complete incompatibility does not allow the construction of transformation functions at all. A valley bottom might consist of highly productive agri-

FIGURE 2 (after G.R.Gregory, 1955)

Determination of optimum combinations from relationships of total cost and total revenue

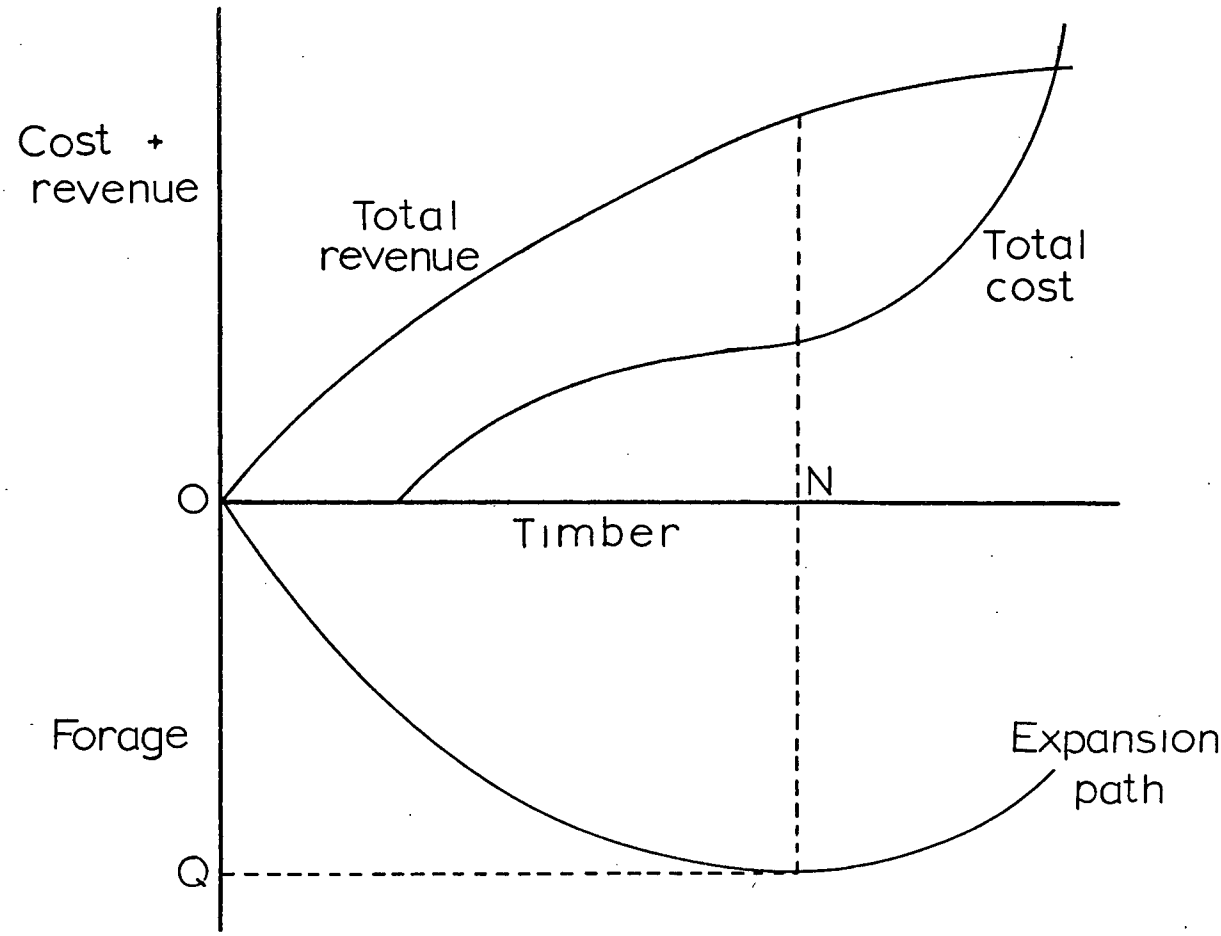


FIGURE 3

Transformation Functions of Two Semi-compatible Products

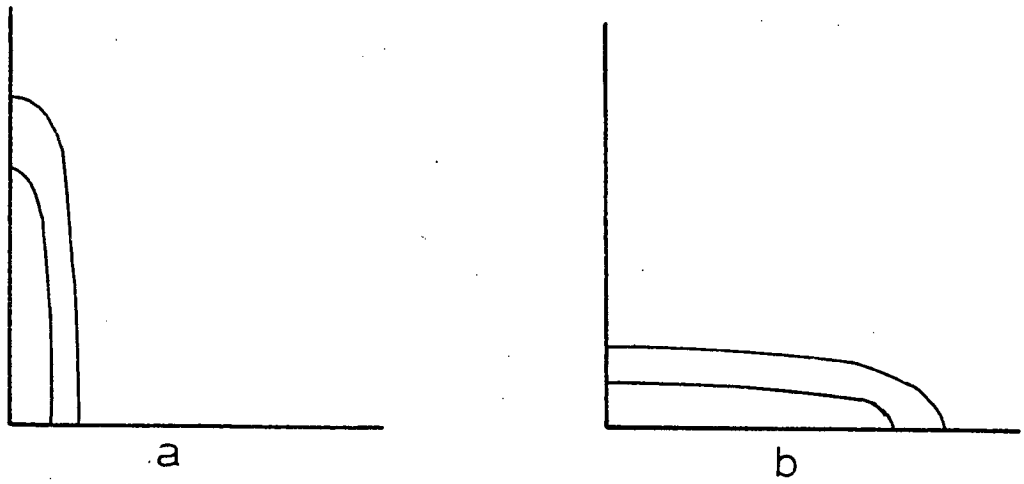
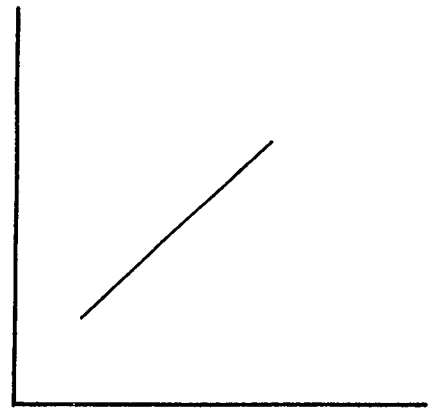


FIGURE 4

Transformation Function of Complementary Products



cultural land and yet be suitable for flooding in a water storage project; the one use only being made possible by the complete absence of the other.

In Figure 4 the iso-cost line indicates that the two products are not rivals, but are in fact complementary, i.e. the production of more of one product resulting in an increase of the output of the other. Such complementarity is rare in land management, but may apply in some cases to the production of timber and water in a particular watershed: intensive management of timber resulting in higher volumes of timber and water within certain limits, and provided that certain precautionary measures are observed.

G. R. Hall (1964) made a valid criticism of the application of this optimizing theory to certain problems involving wildland resource management. His main point was that output quantity and quality (i.e. product characteristics) are in some cases interdependent, and to ignore this fact results in some very misleading conclusions.

When the problem is one of optimizing the combination of cattle and sheep, the thoery of substitutive analysis is unchallengeable. However, a different situation exists where one attempts to optimize the combination of cattle and deer because deer do not really form one of the products; their value lies in providing hunting (recreation) experience. Ungrazed land provides a natural population of deer, and the hunting experience will be gained in a sort of wilderness area. The introduction of a limited number of cattle may have little effect on the deer population but will change the environment in which the hunting takes place, thereby changing the values created by the deer. A large number of cattle will reduce the deer population and severely reduce the hunting experience.

In Figure 5, C deer and O cattle represent wilderness hunting, but with C deer and J cattle the hunting is different, i.e. the characteristics of the product are different; similarly for H deer and G cattle. Thus for a better assessment of the possible combinations a separate demand curve for each different product i.e. for each point on BC must be made: no single price line will apply.

Every point on the vertical axis is different in qualitative as well as quantitative terms. Hall's budget lines (comparable to Duerr's iso-revenue lines) KL, KM etc. are the price ratios of cattle and different hunting experiences. Thus there will be an infinite number of such budget lines and their intersection (or tangency) of BC will only be relevant if the slope of the line represents the price ratios for the cattle and the hunting represented at that point of intersection on BC.

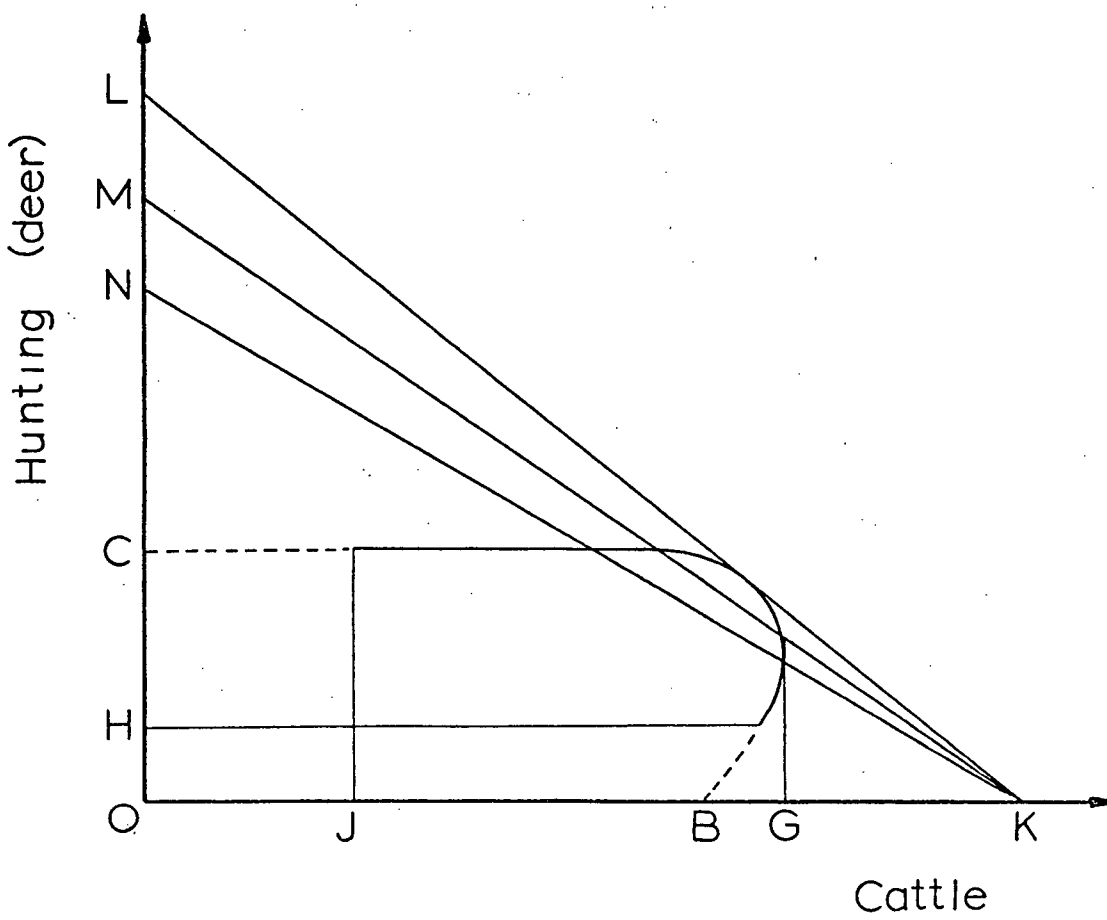
Such budget lines cannot yet be determined with much meaning, but it is obvious that changes in the product characteristics must be afforded due consideration in the application of this technique for aiding land management decisions.

These illustrations of two semi-compatible products lend themselves to graphical representation, but in reality such simple problems seldom occur. More often wildlands have demanded of them a considerable number of outputs, some of which conflict with one another. Skillful extension of the graphical method can only accommodate three products simultaneously, but further approaches to reality increase the complexity of the process of optimization and one must resort to pure mathematics.

Such techniques for determining optima have not met with wide application in problems of land management, nor are they likely to, for the following reasons:

FIGURE 5 (after G.R.Hall 1964)

Relationship of Semi-compatible Products with Interdependent Product Characteristics.



1. The object of such techniques is usually profit maximization. In some industrial situations such an objective is a valid one, but in the management of wildland resources it has become evident that this is not always the goal that best meets the needs of the referrent group.

Two of the fundamental tenets of the free market system (which is supposed to promote economic efficiency), state that "social costs" and "social benefits" must be assumed away. Such non-marketable considerations have become known as externalities and in the past they were, in most cases, ignored or excused, community development and the accumulation of wealth being considered of greater importance. However, in North America in particular, a high standard of living has been generally achieved, and more and more concern is now being shown for the environment in which people live, work and play. The field of economics has been reluctant to accommodate this change of emphasis.

The resources that give rise to these non-marketable values have become known as "amenity resources." Under this heading, Miller (op.cit.) included topography, climate, vegetation etc. "the economic significance (of which) shades off into another realm where significance is felt through influencing the non-marketable, qualitative aspects of living, that is, the way of life as distinct from the standard or location of living" (original emphasis). Miller quoted J. J. Spengler as having said, "experience in this field is showing that amenity resources are as significant or even more significant than some components of the GNP."

2. Like any other technique that attempts to deal with the generation, allocation and distribution of non-marketable values, economic optimization suffers because the values defy accurate quantification or evaluation.

BENEFIT-COST ANALYSIS

A tool that has been developed in the field of economics to aid administrators in deciding which of a number of alternative projects to adopt, or in justifying a particular course of action is that of Benefit-Cost Analysis. The summation of the benefits from a proposed project are compared against the total cost incurred, and a ratio of the two is obtained. Where one project must be chosen from a number of possibilities, the one with the highest benefit-cost ratio is selected: where a single project is involved, if the ratio is greater than one, then it is economically justifiable. Essentially the analysis involves the following (see Sewell et. al. 1965):

1. Identification of Benefits
   a. primary benefits: gains accruing to users of a project, theoretically in terms of what they are willing to pay;
   b. secondary benefits: stemming indirectly from the establishment of the project;
   c. indirect benefits: not expressed through the market system but accruing as a result of the project.
2. Identification of Costs
   a. primary costs: goods and services that must be surrendered in order to construct and operate the project;
   b. secondary costs: arising as a result of the production of secondary benefits;
   c. indirect costs: non-marketable values that are lost as a result of the project.
3. Comparison of the total benefits and total costs to obtain the benefit-cost ratio.

For the analysis to be completely effective all costs and benefits should be in commensurable terms. As pointed out for the technique of economic optimization such is not yet possible when dealing with wildland resources. Since the indirect or non-marketable costs and benefits are now being considered of equal or greater importance to the marketable values, the failure of the analysis to deal with them renders this technique of limited usefulness to the resource administrator. However, the identification and orderly consideration of all factors involved in such a debit-credit method helps to remove the decision-making process from the realms of the "dollar only" attitude of the investor, and the emotions of the sentimentalist to a more rational base.

LINEAR PROGRAMMING

This mathematical technique developed mainly by economists, is designed to "maximise or minimise the solution to a multilinear equation, the independent variables of which are subject to a series of constraints in the form of linear inequalities"(Haley, 1966; see also Dorfman, 1953 and Charnes et al. 1953). Any problem which can be reduced to this relatively simple form can be solved by linear programming.

In accommodating climatic, physiographic and biological variables, linear programming has found some use with forest managers attempting to find the best management alternative for their timber resources (see for example Curtis, 1962 and Loucks, 1964).

The application of this technique, however, is dependent upon the assumption of linearity, i.e. that all the productive functions are of linear form. In dealing with the array and interactions of resources that integrated resource management seeks to encompass, the assumption of linearity

is not valid. A further assumption of linear programming is the existence of perfect competition in the product and factor markets. Even if these assumptions could be satisfied, this method of allocating resources is no better equipped to handle non-marketable values than any other economic technique.

PROBLEMS WITH OUTDOOR RECREATION AND ENVIRONMENTAL QUALITY

Two of the facets of integrated resource management where lack of quantification and/or evaluation is most severely felt, are those of outdoor recreation and environmental quality.

Outdoor recreation is the use of wildlands that has seen the most dramatic increase in recent decades. The need for evaluation is based on the fact that for a recreation project to be implemented it must be economically (to most administrators "economically" means "financially") justifiable to those who are presently in decision-making positions. User-fees that truly reflect the recreational value of the area would, in most cases, be prohibitively high and socially unacceptable for two reasons. On the one hand such fees would probably be so high that few could afford them, thus the area would be under-used; on the other hand such high fees would preclude most income classes and deprive them of the outdoor experience. Consequently outdoor recreation remains in public hands, and is administered as a common good. In many North American provincial and federal parks, the user is charged a small nominal fee to help offset administrative costs.

As competition for land and natural resources grows keener, qualification and quantification of outdoor recreation must be improved so that accurate comparisons and decisions can be made concerning the use of particular tracts of land. Since an appraisal of outdoor recreational values cannot always be

made through the market system, dollar values have been imputed by various indirect methods, none of which are entirely satisfactory.

The term "visitor-day" (defined as a stay of one person in a recreational area of between seven and twenty-four hours (U.S. Forest Service, 1959)) has gained some acceptance as an index of use of a recreation area. It can be computed from knowledge of the area's recreation potential (i.e. its appeal and the number of visitors it can accommodate), access to the area, distances to nearest cities and size of population (see e.g. Clawson, 1959, Ullman 1964, Robinson 1966). With such an estimate of visitor-days of use, a financial value for the area can be imputed by estimating what an individual will spend to gain the experience. Another way of obtaining an estimate of an area's value as a privisor of outdoor recreation is by asking people what they would be willing to pay to obtain the recreational use of the area in question.

Concern for environmental quality is of more recent upsurgence than outdoor recreation, and is becoming increasingly important in discussions relating to resource exploitation. By economic standards this facet of resource management deals almost entirely with externalities and is therefore conventionally overlooked, ignored or neglected.

Some externalities can be evaluated, e.g. financial losses to the fishing industry caused by the destruction of spawning beds in a stream polluted by pulp mill effluent. Perhaps an estimate of the value of the losses to sport fishermen could be made, but the obstruction of scenery by the mill's pollution of the air, or the unpleasant odour, no matter how harmless to health, cannot as yet be evaluated.

As previously indicated, concern for environmental quality is generally exercised only by those who can afford to take such a critical view. Such

concern only materializes into reform when disruption of the guilty industry does not extend beyond the point where the community's rate of economic growth is endangered. Nevertheless concern for these externalities has become a fact of life in North America and every exploitation proposal is being forced to take into account public wishes.

The lack of assistance from the theories of economics for management of outdoor recreation or environmental quality must not be the cause of their being omitted from planning for integrated resource management, since they form part of the demands of referrent groups.

CONCLUSIONS

As shown in the preceding pages, the achievement of integrated resource management can be expected to be complex and difficult. As a first step toward implementation, it would be logical for existing administrations to employ an economic technique that offers simplicity with speed and effectiveness. Of the techniques described, Benefit-Cost Analysis offers these points in a rational approach to resource development. If adopted and performed comprehensively for proposed development projects, this technique would at least provide a surer foundation for decision making concerning resource development, than the ad hoc methods used to date.

When increased demands are felt for integrated resource management, more sophisticated techniques (such as the one described in the next chapter) will become desirable.

CHAPTER VIII

SYSTEMS ANALYSIS AND RESOURCE MANAGEMENT

INTRODUCTION

The dictates of economics and politics have encouraged academic circles to sustain the single-minded approach to resource exploitation that is so common to government and industries, and to embody it in individual disciplines. The discipline of ecology is the only one to have consistently concentrated upon the interactions of living and non-living units of the universe, thereby requiring information from numerous fields. Recently some ecologists have recognized that man must be considered as a biological phenomenon within the ecosystem, and that much of the knowledge gained to date in single disciplines must be brought together, if there is to be any effort at resolving some of the imminent problems concerning man's survival.

The inclusion of man in ecological considerations provides a more rational and accurate standpoint from which to view the effects of resource exploitation. At the same time, however, it increases the complexity of the problem, for man's behaviour towards his environment cannot be described without due consideration of such social effects as economics, politics, religion,

psychology, etc. Since descriptive ecology must of necessity include quantitative information, the introduction of man's social structures renders the techniques of economic analysis (described in Chapter VII) of limited use in problems that must be tackled by those who seek to implement integrated resource management.

The principles of operations research that were developed during the Second World War, coupled with the facilities of modern, high-speed, digital computers with large "memory" banks, have led to a method of expressing complex problems in the form of mathematical models. Such a procedure has become known as systems simulation, and subsequent manipulation of the simulation model, is known as systems analysis. The employment of these techniques offers the possibility of expressing a situation (e.g. the parameters of integrated resource management) in the form of a model, and using a computer, to explore intuitively chosen management alternatives, before a final decision is made upon a management plan.

The application of systems analysis to ecological problems is a relatively new venture (see Broido et al, 1965). The following pages seek to outline the concepts involved in this application and to show how systems simulation and analysis might be used in integrated resource management.

PRINCIPLES OF SYSTEMS ANALYSIS

Rapoport (1968) defined a system as "a whole that functions as a whole by virtue of the interdependence of its parts." Such a functioning whole becomes the unit of investigation and can be defined in any terms convenient to the researcher. In biology the unit might be an organism; in physics it might be a molecule; in political science, a nation, and in anthropology, a culture. Watt (1966) defined the system as "an interlocking complex of

of processes characterized by many reciprocal cause-effect pathways," i.e. the functioning of one part or process being dependent upon the functioning of another.

In each of the above examples the system's behaviour is the resultant of the co-ordinated functioning of its separate parts. (In most cases these parts are worthy of consideration as systems in their own right.) Thus, observation of the system's behaviour allows us to perceive only thegross results of the integrated actions of the parts of the whole and it is only by subdividing (sometimes arbitrarily) the system into components which can be investigated separately that we can gain a better understanding of the system and its behaviour.

Resulting from previous academic development, a considerable amount of segregated information is available which may or may not be relevant to the study of a system. By attacking problems the other way round, i.e. from the whole to the parts, the hallowed seclusion of many disciplines is dispelled and it is possible to see where gaps in our knowledge exist and how they should be filled.

The consideration given to a system can be as complex or simplistic as we care to make it within the constraints of meeting previously stated goals. The closer reality is approached the more complex the system becomes. This is particularly true of the biological sciences. Inasmuch as "the biologist seeks to analyze a system rather than design one" (Quaster, 1963) he must be prepared to contend with the complexity he finds in order to attain his goals.

A program of interdisciplinary research based on the traditional approach of "hypothesis, experiment, observations, analysis, results and conclusions" is one way of attacking problems. Such an approach, however, becomes redundant as the complexity of the problem increases, even more so in biological

problems where complexity is confounded by spatial and historic factors (Holling, 1966).

Holling (1968) identified three major points that must be considered in the application of systems analysis to ecological problems involving man:

1. The adaptions that organisms make in response to fundamental stimuli must be discovered. (In modern ecology such adaptations are known as strategies.) "The expression of these strategies is through a given tactical situation and the limitations inherent in the organizational structure, temporal and spatial relations at the tactical level will impose boundary conditions that will affect not the optimum expression of the strategy, but the possible one." (Holling ibid.) (Original emphasis.) (Tactics in ecology refers to the mechanism responsible for an ecological reaction.)

2. The application of a major research program so that the processes inherent in an ecologic system can be expressed mathematically. With the adoption of simulation techniques it becomes possible to determine the characteristics that a process must have in order to satisfy a strategy of nature.

3. The inclusion of man's strategies is imperative for the completion, integration and direction of the results of a program dealing with man's behaviour toward his environment.

> "When man manipulates a food resource, for example, his strategy is to maximize the productivity per unit biomass. This is quite different from nature's strategy, since communities with such high productivity are often temporary stages in a succession that leads to a stable community with a low productivity-biomass ratio. But having identified a different strategy for man, we can turn to the appropriate tactical models and discover the exact conditions that will best satisfy man's strategy and, moreover, show how those communities formed by nature's strategy can be modified. As man begins to be concerned with multiple uses for single resources--for recreation, wildlife and wood products for example--the identification of man's optimum strategies be-

> comes a highly complex task involving economists, social scientists, engineers and biologists. This area, more than any other, has been largely ignored and the few gestures made towards elucidating man's total strategies have not occurred in conjunction with analyses of nature's strategies and tactics. This results in inevitably limited and vague postulates that generate equally limited and superficial applied programs." (Holling ibid.)

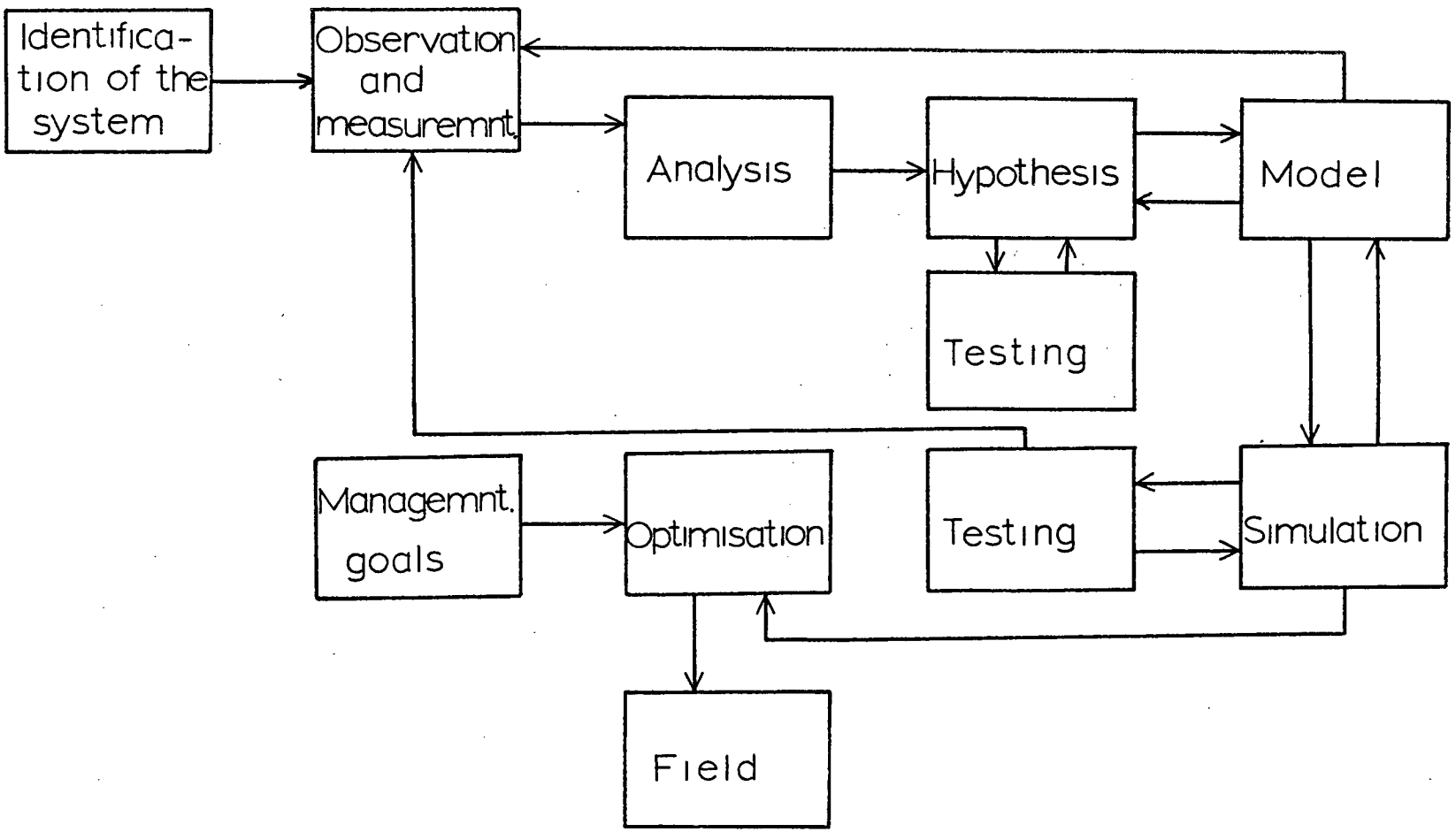
The analysis of a complex system is facilitated by the adoption of a standard approach, which can be shown diagrammatically as in Figure 6.

I Identification of the System. The system to be studied will depend upon the problem in hand. In integrated resource management, the system is man and the ecosystem of specified area. It is not likely that all the components of the system will be apparent at first, but through intuition and observation, sufficient material will be available for the model building procedures to commence. Omission of components invariably occurs and must be rectified, and hypothetical functions must be refined, as the model building progresses and reveals deficiencies.

In some biological problems to which systems analysis has been applied, an initial objective has been not the production of a simulation model of a specific process but of processes that apply in general to several situations. This approach entails the determination of basic processes from specific, but not unique, cases. An approach known as "experimental component analysis" (Holling, 1966) has been designed to organize and direct such an analysis. The basic components or procedures of a complex process, Holling (ibid.) defined as being shared by all examples, and underlying all the manifestations of the process: other components, present in some situations and not in others, can be called subsidiary or sporadic (or specific).

The basic components of integrated resource management relate to the factors of supply, demand and biological constraints of the renewable resources.

FIGURE 6 Flow chart of the steps involved in the employment of systems technique



In dealing with a particular specified area, subsidiary or specific components would apply to the uniqueness of these factors that are the result of the local referrent group(s) and ecological peculiarities.

II Observation and Measurement. "The first step in studying a complex system is to develop a comprehensive list of the variables and causal pathways that seem of potential importance in determining the functions of the system. Such knowledge will be obtained from information in the literature, a priori considerations, field observations or formal plot studies" (Watt op.cit.).

Perhaps the most important problem is the identification of the relevant variables to be measured. So often quantitative enquiries are made for the purpose of satisfying the needs of a particular discipline that are not at all pertinent to the resolution of the behaviour of the variable in the system. That which is to be measured is dependent upon the part played by the variable being studied in the functioning of the whole. For instance, in the context of resource management it is comparatively easy to measure only those variables that can be expressed in dollars, omitting consideration of externalities.

III Analysis. The determination of which variables are important to the model is accomplished by using multiple regression analysis and multiple analysis of variance and covariance. Only those variables that contribute significantly to the variance of dependent variables are retained in the model.

IV Hypothesis. Preceding the construction of the model of the system it is often necessary to hypothesize how the variables fit into the behaviour of the components, and the components to the system. Whenever possible the validity of the hypothesis of the relationship between variables must be

tested against real data, before they are incorporated into the model. In this way gaps in information can be recognized and corrected and hypotheses refined before the model is developed further.

V Constructing the Model. At this juncture the components are integrated to form a semblance of the system in mathematical terms. Based on the previous data and hypotheses, the instructions are given to the computer in the correct sequence, thresholds and discontinuities being correctly identified, quantified and programmed. The first "run" of the model will demonstrate the proficiency of the researcher and programmer in constructing the model. The process of "de-bugging" the model ensues when questions may be asked of the hypotheses, the original measurements or the "grammar" of the program.

VI Simulation. With the model in an operating condition it is possible to feed in real data and to examine the output for its proximity to reality (or absurdity). Testing the model in this fashion provides the criteria upon which to judge whether or not all the components of the system have been included, and whether the interactions between them have been correctly identified and programmed. Until the model faithfully simulates the system being studied it is pointless attempting to obtain optima.

VII Optimization. The simulation model can now be used to illustrate the effects of manipulation of the system by varying the input data, changing the conditions of the functions or by altering thresholds etc. In this fashion different management strategies can be tested and it is now possible to compare the goals of management subject to various constraints with demands placed upon them. In other words, using the simulation model to correlate the demands and physical outputs, we can optimize the system and obtain an optimum combination of resource outputs that best meet the demands without destroying the system.

However, with the complexity encountered in the multi-dimensional and non-linear models of the kind envisaged for integrated resource management, standard optimization techniques are inadequate. Recourse must be made to intuitive exploration of various management decisions in the light of prevailing conditions.

THE APPLICATION OF THE PRINCIPLES OF SYSTEM ANALYSIS TO INTEGRATED RESOURCE MANAGEMENT: AN EXAMPLE

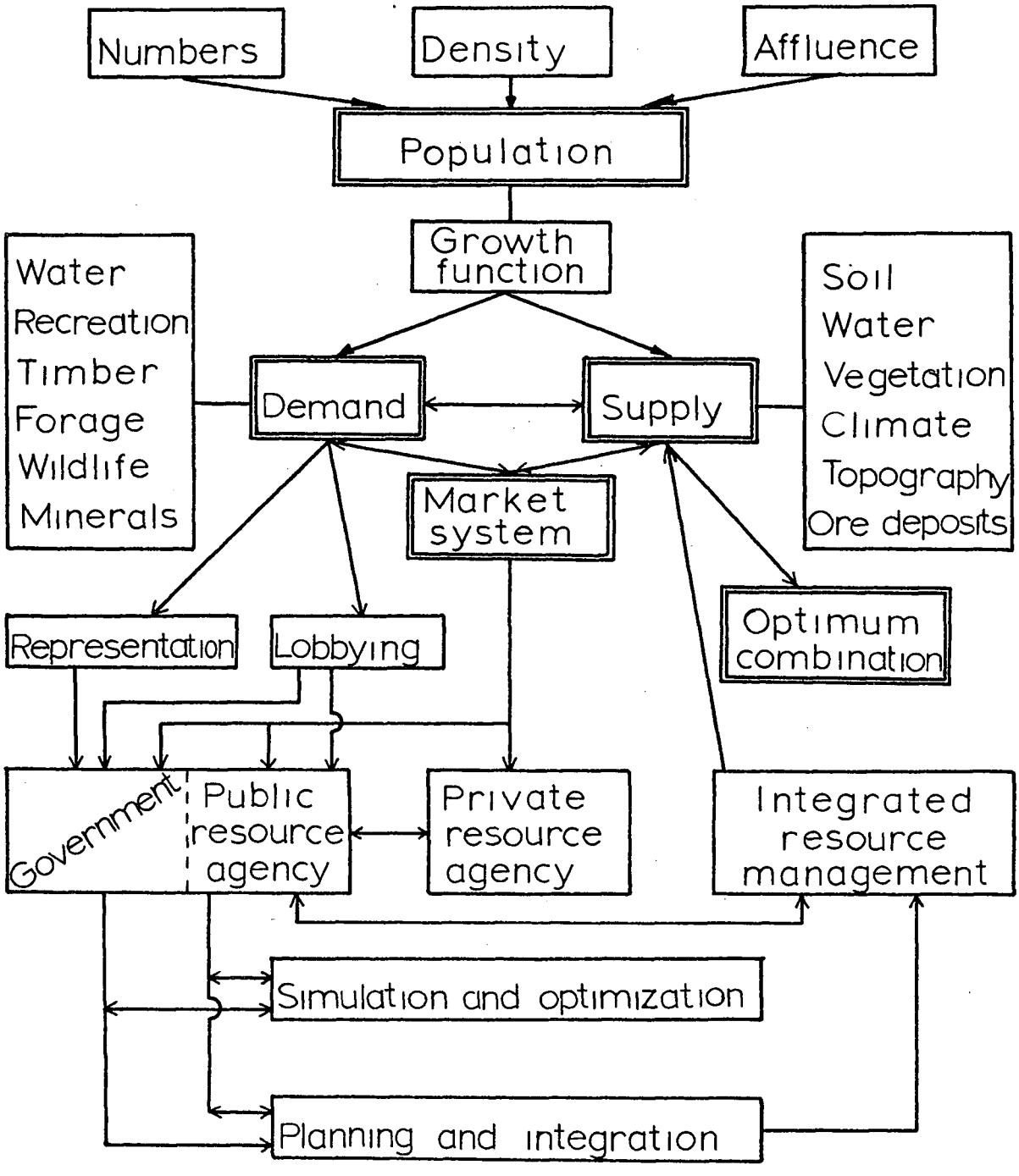
As has been shown, the greatest obstacles in any attempt at coordinating resource management are political. If systems analysis is to be applied to integrated resource management, then it must accommodate a political system. It is doubtful if any presently existing administration could contemplate the implementation of integrated resource management as defined herein. Thus it has been necessary to postulate a simplified political system in which systems analysis might profitably be employed to resolve resource management problems.

In setting up such an example it has also been necessary to simplify the physical attributes of the system. A description of a real human ecosystem would be of enormous complexity and beyond the scope of this paper. There is also the possibility that a real system would exclude some components that are common to others. It has therefore been decided to include some of the more obvious basic processes inherent in such a system so that the ideal of integrated resource management would be hypothetically possible. In so doing, the following considerations have moved so far from complex reality to the realms of simplicity that they deal with the entirely theoretical. (See Figure 7.)

The example assumes (a) that the land area has been defined and with it a particular population or referrent group; and (b) that the goal of manage-

FIGURE 7

Diagram of hypothetical model for simulation of integrated resource management



ment is the maximum satisfaction of public demands for wildland resources without impairing their reproductive potential.

The following components have been included in the example:

1. the population for whom the resources are being managed and whose characteristics are constantly changing with time;

2. the demands that are made upon the wildland resources that change concommitantly with changes in the population's characteristics;

3. the supply of natural resources on the specified area;

4. the methods by which the demands are communicated to the decision making arm of the government;

5. the decision making sector of the government, that in the light of other considerations, modifies by various means the demands on the resources;

6. the resource management agencies that are government controlled, and who are assumed to have complete knowledge of the resource potential of the area;

7. the optimizing process. This government is unique in that it has complete knowledge of the modified demands and the resource potential, and a computer simulation model with which to optimize resource outputs;

8. another branch of government that plans the integration of the resource agencies using the results produced by the optimization process;

9. integrated resource management, that applies administration directives to the specified area and results in an optimized combination of resource output that maximizes public welfare.

Considering the components in further detail:

1. the population. Human populations can be described in terms of their characteristics, e.g. their numbers, density, age structure, family units etc.

as well as their economic status. This will include such items as the average wage for each type of employment, average disposable income, numbers of wage-earners per family *etc.* Much of such data can be obtained from census reports and, by extracting from earlier reports data pertaining to the characteristics determined as important to the model, it becomes possible to observe and quantify how the characteristics have changed with time.

The relationship of each characteristic and time can be described by a mathematical function. By subjective consideration of such factors as economic potential of the area, recreation potential, future residential desirability *etc.*, it is possible to assess whether or not the same function can be used to extrapolate the relationship into the future. By putting into the computer data of the population's characteristics at a given time and the corresponding mathematical functions, it is possible to obtain information for the population at any subsequent time period.

Let us suppose that analysis of all possible population characteristics shows that the three that most influence the model are size of population (*i.e.* numbers of people), population density and the economic status which has been confined to average disposable income.

It next becomes necessary to show how these characteristics change with time. Hypotheses are formed of the relationships and expressed mathematically. By applying real data to the hypothesis it is possible to test and adjust them where necessary so that they conform to reality.

Graphically, the relationships of populations characteristics, based on valid assumptions might appear as illustrated in Figure 8.

2. The Demands. To obtain the relationship of the population's demands and resource outputs, it is most important that the correct resource variable is identified in those units of measurement that the population consumes.

FIGURE 8

Hypothetical changes of Population characteristics within a planning period (e.g. ten years).

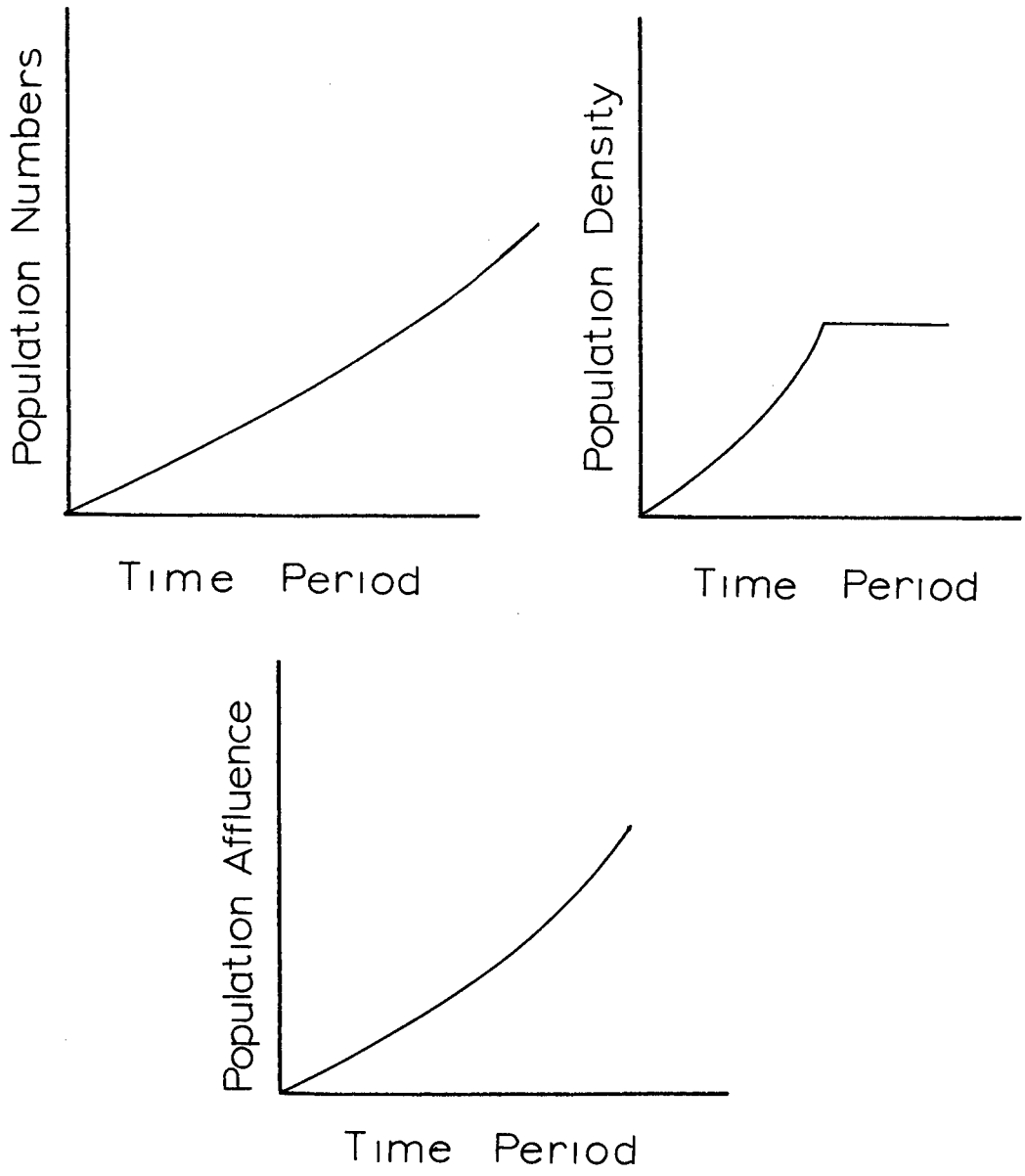
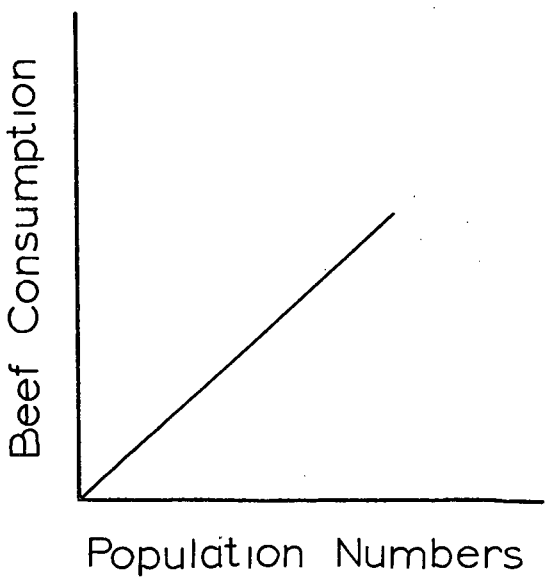
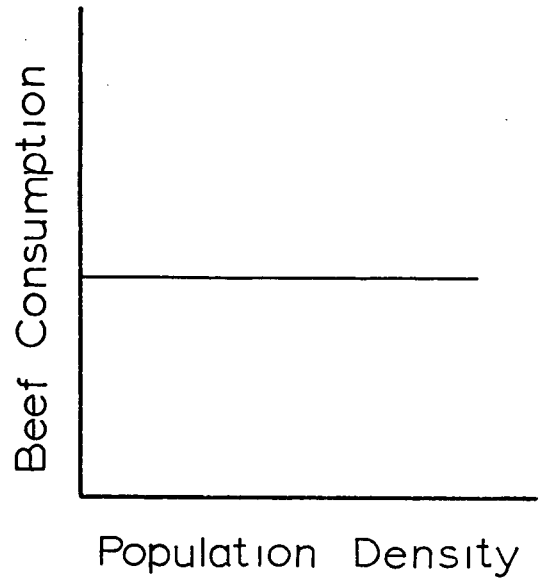
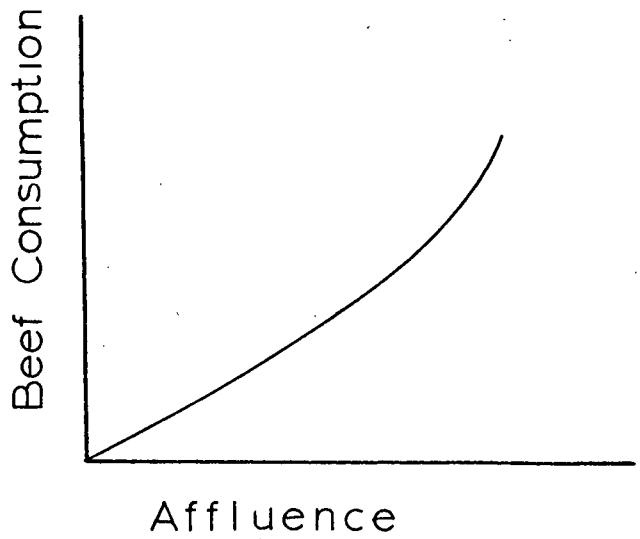


FIGURE 9

Hypothetical Relationships of Beef Consumption and Population Characteristics







For example in an analysis such as this the demand for range land is not expressed in acres but in the average weight of beef consumed per head per day.

As has been said, the resource demands will change in response to changes in the population characteristics and it is necessary to identify the relationship between each resource output and each population characteristic.

For example, we might find from investigation and tested hypotheses that the relationships between beef consumption and population numbers, density and affluence appear as shown in Figure 9.

The picture becomes more complicated with those resources that have more than one consumer product. The timber trade for example might find demands for fuelwood (cordwood), lumber and pulpwood and each of these must be related to each of the population characteristics.

The interactions of competing demands on the same resource constitute another complication e.g. the use of forest land for timber products, recreation and watershed protection. The economic techniques and difficulties in deciding which demand, if any, is given priority over others have already been discussed (Chapter VII).

Since the population characteristics are all positive, most of the demands on the resources show corresponding increases. Hence more intensive management of the resources will become mandatory. The more "capital-intensive" management becomes, the more it tends toward single use rather than multiple use and thus a scheme for closely integrated resource management becomes more and more necessary in the attempt to minimize conflicts and maximize public satisfaction.

If the resources of the area are inadequate to meet the demands of the referrent group, investigation should be made into the feasibility of obtaining a larger specified area as a unit for management. If this is not possible and the importation of most basic resources is unavoidable, it is possible that much of the area may best serve the referrent group by being maintained for a single purpose, e.g. recreation.

3. The Supply. Wildland resources can be classified as:

(a) Amenity Resources (Miller op.cit.) constituting climate, topography and vegetation, and being responsible for recreational and aesthetic values. Apart from intensive recreational use that may destroy certain vegetation phenomena, these resources cannot be influenced through normal use.

(b) Non Renewable Resources, e.g. ore-bodies, fossil-fuel deposits etc. Considered alone, these are amenable to the dictates of economic theory and the law of supply and demand. However, their exploitation invariably gives rise to externalities of varying degrees of severity, which are capable of upsetting the system, e.g. acid mine-waste that eventually effects water courses and the livelihood of those populations that depend upon them.

(c) Renewable Resources include soil, water and vegetation, and more specifically natural forest, grasslands and wildlife. A natural forest illustrates the characteristics of renewable resources in having: (i) an immediate and total exploitable capacity, e.g. the standing volume of the virgin forest that can be completely wiped out by man's utilization in a given time period; (ii) powers of reproduction--the forest, as an example of a renewable resource,

has the ability to maintain a dynamic equilibrium with its environment, by offsetting the effects of death with the production of offspring; (iii) a threshold beyond which the reproductive powers of the resource are either incapable of returning it to a condition similar to its untouched state, or to do so would require long periods of time. It has been found that a certain minimum quantity of forest, known as the "growing stock" must be maintained if man expects to obtain a sustained yield of forest products: continued overcutting reduces the growing stock and eventually will wipe out the forest: undercutting allows the forest to approximate its natural equilibrium where volume losses through natural mortality are balanced by natural regeneration.

Such a threshold corresponds to a biological constraint, and for each use of each resource, the biological constraint should be determined and used as a criterion for management where continued use is demanded. When a constraint is overstepped the resource in question is not the only one to suffer--the effects are felt upon the whole system. The over-grazed pasture not only results in a smaller carrying capacity and a depleted meat market but sheet and gully erosion become imminent disasters. Not only does this confound the range manager's problems, but eroded material finds its way into streams and rivers resulting in choked watercourses, with serious repercussions on fish populations and recreation potentials, not to mention the possibility of floods and direct danger to human life.

Thus the observance of the biological constraints are of the greatest importance in resource management. They are known with varying degrees of accuracy for most renewable resources. It is

essential that they are entered in the model in such a way that when compared with demands that exceed them, the computer output will immediately show the fact.

Using real data and with the functions correctly identified the computer can be programmed to out-put the demands for all the resource products for varying social conditions. Whether these demands are met entirely from the land area in question or not must be determined by the government from the results of simulation trials, and in collaboration with its resource agencies.

4. Communication. In the example demands are communicated to the government in any or all of the following ways:

(a) Representation: demands known to a particular member of the government (who may have been elected on a particular "pork barrel" platform) who is thus ideally situated to communicate directly with the decision makers;

(b) Lobbying or pressure groups: often representatives of minority groups are particularly important in considerations dealing with non-marketable values. Both the representatives and the pressure groups are able to influence the demands and supply of natural resources by various propaganda devices in an attempt to achieve what they believe is "socially desirable."

(c) The economic market system: this is the most important way in which people's wishes become known--by their willingness to pay for what they want. Whatever the government's motives for doing so, it may seek to influence the market system by various fiscal policies. It may also influence the demands more directly, e.g. the imposition of bag limits and "seasons" in hunting.

In capitalist societies, most resources are exploited by private interests, over whom the government has minimal control. The market system invariably

by-passes the government to influence the companies directly. If this caused economic competitions and regard for externalities, resulting in resource exploitation that met with public satisfaction then the market system could be wholly justified. In the example, the shortcomings of the market system have been avoided by giving the government's resource agencies more control over the activities of private interests so that externalities can be ensured of consideration in wider public interests.

5. The Government. The role of the government is that of a single, central agency that has the knowledge and authority to bring about the integration of planning for resource exploitation in a fashion that maximizes public welfare.

It is envisaged that plans for exploitation will be updated regularly, perhaps annually. Resource agencies, assumed to have complete knowledge of inventories and potentials (biological constraints) of their resources, will present updated information to the government's simulation model on a similar time basis. When resource demands are received the simulation model is used to reconcile them with attributes of the supply, with full recognition of the interaction (externalities) of each development, upon the whole system. Simulation and optimization may indicate that some demands must be modified in the light of other factors. For instance, interest of a wider range than that of the local referrent group is likely to be given precedence over local interests: budgetary constraints may curtail those demands that entail a high initial outlay, etc.

The realistic inclusion in a simulation model of components to handle the interactions between resources is presently severely limited because of a lack of both qualitative and quantitative information. This is a relatively straight-forward technical problem that can eventually be overcome. In the

meantime, were such a complex model contemplated, these deficiencies could be partly repaired using intuitive assumptions of values and hypothesising unknown functions based on preliminary observations.

To illustrate the complexity of the interactions consider the situation where one of the demands that must be accommodated by the resources of an area, is for a certain volume of timber. Suppose this volume necessitates the logging of untouched natural forest: the effects upon the system of such an activity can be expected to include the following:

(a) logging inherently means access roads. What effect will these have on opening up the area in terms of the wildlife potential (hunting and fishing of hitherto unexploited fish and game populations), on the recreation potential and increased fire hazard? What will be the effects of road construction on water quality?

(b) not only the road construction but also the actual logging operation may affect water quality through pollution from erosion. Thus information is needed of climatic, geologic and pedologic conditions which will influence the type of equipment used and the design of road and logging layouts;

(c) in some critical areas water regime may be seriously upset by the removal of evapotranspiration agencies (i.e. trees) and by ground compaction causing spring floods and late summer droughts. Is there a scale of operation that will maintain a reliable water supply?

(d) the preceding items may or may not affect human consumption, yet may have serious consequences for fish populations. Removal of trees along river banks may result in lethal changes in oxygen content and water temperature; logging activities may cause destruction of spawning beds either directly or indirectly. Thus data are required of what

populations are present, which ones might be affected, what is their value from the point of view of commercial and recreational fishing and what are the tolerance levels of the various species to different environments;

(e) widespread logging can result in the change of wildlife populations from the species that live in the mature forest to those that are more adapted to the seral stages of vegetation. What species are present on the area proposed for logging and what is their value to the hunter? How will they be affected by logging operations in terms of winter feed and shelter etc.?

(f) what of the recreation potential? How will the change in scenery, water quality and quantity and wildlife populations affect the camper and the hiker?

Having, hopefully, identified all possible interactions comes the task that is presently impossible to fulfill, the task of quantifying these effects and defining the relationships as mathematical functions. For example, the relationship between number of board feet of timber produced and the level of sedimentation expressed in parts per million for a given situation in the area must be known, similarly the relationship between volume of timber production and inches of water gained through removal of the trees, and so on.

This analytical process is repeated for each resource base in turn, first considering the quality of the interaction and then its magnitude. The functions are then programmed and placed in the computer. The final simulation model can then be used to determine the optimum output of the resources in response to the demands placed upon them.

If all the resource outputs and interactions could be quantified and evaluated, the simulation model could be constructed so that a benefit-cost ratio could be obtained for each exploitation project. Since the evaluation of externalities is not possible, the computer out-put would be limited to a presentation of the physical units involved, and a comparison with the related biological constraints. This in itself would be of enormous value in providing quantitative information upon which the government could base value judgments.

The following sequence of steps will illustrate the kind of operations that such a simulation model might go through in producing an optimized combination of resource outputs in response to the input of demands.

1. Within the next planning period (this could be a year or more) the population's characteristics can be expected to reach known levels.

2. Correspondingly, assuming that current trends are continued, demands upon the resources will also increase. The computer, utilizing a sub-routine of population growth and resource demand might indicate that by the end of the planning period:

(a) x M.f.b.m. of lumber will be required; more people building houses, richer people renewing houses etc.;

(b) n more visitor days of outdoor recreation must be provided; more affluent, mobile people with more leisure time to explore the outdoors;

(c) w more gals./head/day of water will be used; more people entail increased consumption, bigger and better bathrooms etc.

(d) m head of big game will be sought by hunters, photographers etc.

3. These inputs of demands are then imposed on the supply data stored in the computer's "memory." These data have been furnished by the resource agencies and will be used to indicate how, when, where and if the various demands can be met by the specified area, or ecosystem. Dealing with each

demand in turn, the computer's optimizing process is carried out. In this case the demand for lumber is dealt with first in the following sequence:

(a) the computer determines the location and extent of the logging operations that must be carried out in order to produce x M.f.b.m. of lumber during the coming year;

(b) the effect of these operations (interactions) upon the water supply are then investigated but is found to be detrimental (perhaps the timber is in a steep-sided valley whose slopes have a high erosion potential and logging would cause severe sedimentation;

(c) the model is so set up that in such a case the computer is instructed to search the information on forest inventory to see if the same volume of timber can be found elsewhere; this the computer does and is successful, even though a larger area is involved (because of a smaller volume of timber per acre), but the logging in this instance will not detract from the water quality or regime. If the computer had been unsuccessful in reallocating the demand for timber it would have just optimized the most favourable condition of each resource ("water" only being compromised to specified limits, below which the supply would be useless);

(d) the situation that is satisfactory to the demands for water and timber is compared to the demand for game or more specifically numbers of deer in this case. It is found that the vegetation appearing on the cleared area and the satisfactory water supply are able to maintain an increased deer population;

(e) the computer now compares this optimum combination to date with the n visitor-days of recreation that is demanded. It is found that the reallocated logging, while satisfactory from the standpoint of the water

supply, has drastic effects upon the recreation potential (perhaps the timber was to be taken from around a lakeshore that had great potential for campsites, scenic values would have been lost etc.);

(f) the computer thus attempts again to satisfy the demands by re-allocating them to different locations. The third area proposed for logging is considerably further away from population centres, but does not interfere with recreation potentials, and is suitable for the increased numbers of deer required. However, the production of increased runoff is not significantly greater;

(g) the computer then concentrates on the demand for more water by scanning inventories of areas suitable for increased snow accumulation, reduced melting rates, reduced evapotranspiration losses etc. A suitable area is selected, where a certain amount of forest cutting is necessary, and the scale of the operation is determined so that the required volume of water will result;

(h) these treatment cuttings are investigated for possible unsuitable interactions with the rest of the system. Suppose, for the sake of brevity, that no detrimental effects need be anticipated;

(i) the timber from these cuttings will be harvested and can be counted toward the volume of lumber required by the end of the planning period. Thus the scale of operations in (g) is correspondingly reduced;

(j) the program dictates that "new" operations from (g) be examined for harmful interactions. Suppose again that none need be feared;

(k) with all the demands met in such a fashion, the simulation has run its course and the computer stops.

The results of the simulation and optimization processes are passed to the planning and integration branch of the government. Here the plans and

logistics for integrated resource management are founded. Directives are prepared for implementation by private agencies whose responsibility it is to actually carry out the projects in this example.

If and when the need for integrated resource management becomes sufficiently great, systems analysis and simulation offer the most comprehensive tool for its achievement. Its application in the field of resource management cannot be expected in the near future for the following reasons:

1. Unless political boundaries and administrative divisions can be overcome, integrated resource management, whether based on the results of simulation trials or not, cannot hope to be implemented;

2. The production of a simulation model for such a complex problem would incur an enormous cost, that few at present would be willing to shoulder. Presenting the problem as one of human ecology, renders an inter-disciplinary approach essential. The attraction of those qualified in the various fields would be expensive, not to mention the cost of programmers and computer time.

3. There are few individuals who could claim to be capable of producing such a model even with the assistance of a team of experts;

4. The current lack of both qualitative and quantitative data would confound the problems of programming the interactions within the system when a development project is considered.

However, the adage of "where there is a will there is a way" is still sound. A sufficiently urgent demand for integrated resource management would see the above problems overcome.

CHAPTER IX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

SUMMARY

The following is a list of points that the preceding chapters have sought to make:

1. The ideas and concepts upon which multiple use and integrated resource management (known hereafter as IRM) have been based are not new. They were known to civilizations thousands of years ago living in close contact with their environment. Pressure for natural resources is now being felt by populations resident in cities and alienated from natural elements, and to some people the concepts of IRM appear novel. Such concepts are, however, as old as mankind.

2. The Industrial Revolution was instrumental in severing the direct reliance of many Europeans on natural elements. Since that time, industrialized western man has demonstrated a lack of responsibility towards his environment.

The Conservation Movement arose as a reaction to frequently disastrous resource exploitation and political corruption in America. In preached

"wise use" and consideration of the future, and became a crusade that embraced many social and moral issues. Although many of its principles were etched into the policies of resource agencies, the lack of pragmatism and of a definition of "conservation" led to the crumbling of the Movement as its founders moved on.

3. "Multiple Use" as an identifiable slogan and land management policy grew up with the United States Forest Service, although the wider concepts of managing man's environment as a whole were seen by Pinchot in 1907.

In confining its attention to wildland resources, multiple use achieved a more positive status than the politically orientated Conservation Movement. Although a legal definition was formulated, the implementation of multiple use within the Forest Service still rests upon the personal discretion of each district ranger.

The adoption of multiple use as a concept of management by resource agencies other than the United States Forest Service, has resulted in any meaning that the term may have had becoming obscured, confused and completely lost.

4. Because the term "multiple use" has become such a shibboleth, it is proposed that it be discarded from use and replaced by "integrated resource management" (IRM).

5. In analysing the concepts of multiple use and in seeking conditions for the implementation of such a management concept, IRM will assume the definition of "the application of management strategies to achieve the maximum public welfare from an optimum combination of uses of the wildland resources of a specified area for the benefit of a referrent group."

6. Natural phenomena only become resources when man finds a use for them, i.e. social demand is the sole reason for resource exploitation. In

the competition of the market system, however, where financial success is the objective and in the halls of governments where non-productive objectives are known to revolve about prestigious values, resources have become ends in themselves. This paper seeks to re-emphasize that natural resources are only means in the procuring of public welfare, and that the latter is more important than the resources.

7. Natural resources cannot be considered individually or outside the context of the ecosystem, which includes man and all his activities. The exploitation or development of one resource invariably influences other parts of the whole, and unless measures are taken, this influence is invariably detrimental. IRM as a concept of management will, as far as possible, consider all the interactions that are likely to result when one resource of the ecosystem is proposed for development.

8. In North America, as in other parts of the world, where a certain standard of living has been attained there is growing public concern for the way of living. Much of this concern is directed toward those environmental values, known as "externalities," that do not yet find expression in the economic market system. The philosophy of IRM fully recognizes the importance of these non-marketable values and proposes to give them consideration equal to that given to marketable values.

9. The objective of IRM is the achievement of maximum public welfare from wildland resources. However, for "welfare" to be defined in practical terms, it is necessary to confine attention to certain basic conditions, and to specify: (a) the referrent group(s) (population) whose welfare constitutes the demands upon the natural resources; and (b) a specified area, which can be defined in any convenient terms. Once defined, the area sets the limits of

the resources available (the supply) from which an optimum combination of outputs is produced in response to the demands of the referrent group.

10. IRM requires coordinated planning of resource uses and users within the specified area. Such planning is best carried out by a single agency that has: (a) knowledge of supply and demands, and biological thresholds; (b) the ability to make impartial, evaluated decisions regarding exploitation projects; and (c) the authority to integrate all resource agencies to effect the optimum combination.

11. Inasmuch as the implementation of IRM will require changes in established legal, political and industrial structures, it is bound to meet unbending opposition from such entrenched interests. This opposition constitutes by far the greatest hindrance to any proposal, such as IRM, that requires forms of resource exploitation that approximate public welfare instead of private profits.

This is not to say that physical problems connected with effective IRM do not exist; but whereas these can be expected to be resolved with time and effort, social and political problems are often irrational and exceedingly difficult to alter.

12. Economic theory has not appeared eager in accommodating non-marketable values, and so is of limited use in planning IRM. Ecology, using the tools of systems analysis and simulation models has concentrated its attention on the interactions between the parts of an ecosystem, while recognizing at the same time the difficulties of evaluating the externalities involved in human ecology. As a tool for facilitating comprehensive decision making in IRM, systems analysis shows potential.

CONCLUSIONS AND RECOMMENDATIONS

Integrated resource management, as defined in this study, can only be considered as an ideal, that present socio-political structures are, as yet, incapable of entertaining. However, growing public concern for the quality of living as against the standard of living, indicates that attention must be given to the way in which future resource development should proceed.

This thesis has attempted to demonstrate that in North America, "politics," in both the broad and narrow senses of the word, constitute the biggest obstacle to the implementation of IRM. At the present time it would appear futile to seek voluntary cooperation among government and industrial administrators of natural resources, where objectives of a social nature are involved. Such cooperation that would be vital for the implementation of IRM is not an impossibility, but it is considered unlikely to occur in the near future, or in sufficient time to prevent further negligent, or misdirected decisions being made concerning resource development.

The alternative to cooperation is the establishment of a government department, the function of which is the integration of resource industries, and other government departments so that the welfare of a referrent group is sustained. It is to the political aspects of IRM that the greatest amount of research must be directed. A great amount of information will be needed to determine the most appropriate level of government that should have the responsibility of applying the principles of IRM.

In Canada, where development of natural resources is a responsibility of provincial governments, the establishment of a provincial department for resource integration might be a logical step, though sub-division of a province into smaller management units may be found more convenient in some

cases. As previously pointed out, the establishment of a new branch of government is not to be lightly undertaken. The problems involved in such an undertaking must be carefully weighed against those that will develop when the terms of reference of an existing provincial department are re-defined for IRM implementation, and include a measure of influence over other departments.

However constituted, the terms of reference of the department responsible for IRM must include definitions of:

1. the referrent group;
2. the specified area;
3. a working definition of "public welfare" that applies to the referrent group.

It is not to be imagined that the department responsible for IRM implementation will be capable of achieving maximum public welfare immediately. Rather, it is to be expected that this end will be achieved from small beginnings. As a first step it is suggested that attention be turned to analyzing the new large-scale development proposals for resource development within the specified area.

The number and scale of such development proposals, e.g. mining and drilling operations, water impoundments, etc., have expanded in fantastic fashion in recent years. Their effects on people and other resources can be expected to be far-reaching and profound. Thus it is essential that as comprehensive an analysis as possible be applied at the proposal stages. Benefit-Cost Analysis would appear to be the most appropriate technique that could be used in the early stages of IRM. In applying this analysis to each new development proposal, the department responsible must be empowered to:

1. obtain all relevent information of the total benefits and total costs involved--these not to be limited to purely financial considerations;

2. evaluate them with the referrent group in mind, but otherwise impartially;

3. modify the proposal, or such aspects of it as the department sees fit, to ensure that the maximum public welfare of the referrent group is safeguarded; and

4. integrate the resource agencies involved so that the decision of the department might be implemented.

As a second step towards comprehensive IRM, the department should be expanded, and should direct its attention to the less spectacular but equally important, existing operations involved in harvesting other natural resources within the specified area. Priorities for attention might be established on such criteria as, for example, water and atmospheric pollution, landscape disfigurement, etc. and any situation where the requirements of the referrent group were being subjugated by private motives.

Through the gradual reconciliation of social demands of new projects and existing operations, the department established for these purposes will gain the requisite knowledge of the referrent group and the resources of the area, to enable it to eventually approximate the position of the single coordinating agency required for comprehensive IRM. With such information it is foreseeable that Benefit-Cost Analyses will ultimately be replaced by the more sophisticated Systems Analysis. However for the employment of any of these techniques to be completely satisfactory, research into the problems of quantifying and evaluating the non-marketable aspects of the environment must be emphasized.

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APPENDIX 1

THE MULTIPLE USE-SUSTAINED YIELD LAW

Public Law 86-517
86th Congress, H. R. 10572
June 12, 1960

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled. That it is the policy of the Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes. The purposes of this Act are declared to be supplemental to, but not in derogation of, the purposes for which the national forests were established as set forth in the Act of June 4, 1897 (16 U.S.C. 475). Nothing herein shall be construed as affecting the jurisdiction or responsibilities of the several States with respect to wildlife and fish on the national forests. Nothing herein shall be construed so as to affect the use or administration of the mineral resources of national forest lands or to affect the use or administration of Federal lands not within national forests.

Sec. 2. The Secretary of Agriculture is authorized and directed to develop and administer the renewable surface resources of the national forests for multiple use and sustained yield of the several products and services obtained therefrom. In the administration of the national forests due consideration shall be given to the relative values of the various resources in particular areas. The establishment and maintenance of areas of wilderness are consistent with the purposes and provisions of this Act.

Sec. 3. In the effectuation of this Act the Secretary of Agriculture is authorized to cooperate with interested State and local governmental agencies and others in the development and management of the national forests.

Sec. 4. As used in this Act, the following terms shall have the following meanings:

(a) "Multiple use" means: The management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output.

(b) "Sustained yield of the several products and services" means the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land.