A PLAN FOR COASTAL ZONE INTEGRATED RESOURCE MANAGEMENT IN A DEVELOPING SOUTH WEST PACIFIC ISLAND COUNTRY

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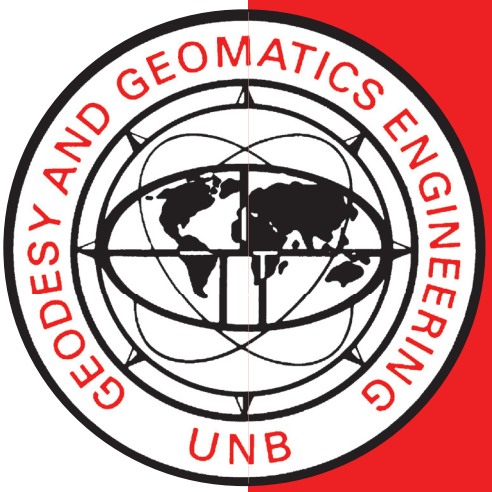
January 1991



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A PLAN FOR COASTAL ZONE INTEGRATED RESOURCE MANAGEMENT IN A DEVELOPING SOUTH WEST PACIFIC ISLAND COUNTRY

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PREFACE

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PREFACE

This technical report is a reproduction of a thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Engineering in the Department of Surveying Engineering, December 1990. The research was supervised by Dr. John D. McLaughlin, and funding was provided partially by the Natural Sciences and Engineering Research Council of Canada and by Energy, Mines and Resources Canada.

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ABSTRACT

The coastal zones of developing nations are subject to current and potential stresses of unprecedented magnitude. The health, nutrition and well being of the people of a relatively poor country such as the Solomon Islands, are directly dependent on the integrity and continued productivity of resources from these areas. The capability of government to manage effectively over the long term is the single most important prerequisite to the fulfillment of basic human needs and the ultimate achievement of sustainable development.

The governments of many developing nations have begun to acknowledge the importance of these issues, but the unwillingness or inability of past colonial or current indigenous agencies to manage coastal resources and protect environmental quality has prevented effective coastal management in many cases. This thesis concentrates on the organisational and process oriented problems of coastal management associated with insufficient coordination of intra- and inter-governmental authorities and inadequate information management techniques.

In this thesis an appropriate coastal management strategy, defined as Coastal Zone Integrated Resource Management (CZIRM) is introduced. Through the analysis of current coastal management programs in a number of different jurisdictions and the identification of a tool for user requirement specification, a plan for CZIRM implementation is developed.

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ACKNOWLEDGEMENTS

I wish to thank :

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* fellow Land Studies Group students, especially Ms Sue Nichols, who were always available for constructive criticism;
* the MacDonald family, who adopted me as one of their own;
* my Mother and Father, who set the example.

DEDICATION

To Tracey Marie.

CHAPTER ONE
THE COASTAL ZONE - INTRODUCTION AND OVERVIEW

> Roll on thou deep dark blue ocean-roll!
> Ten thousand fleets sweep thee in vain;
> Man marks the earth with ruin - his control
> Stops with the shore.
>
> George Noel Gordon, Lord Byron (1818)

Even before the time Lord Byron penned this warning, governments throughout the world have attempted to exert some type of legislative control over the use of coastal lands, waters and resources which collectively form the coastal zone. Coastal management practices have been carried out since early history in an attempt to control naturally occurring modification of the coastal environment as well as to mitigate the effects of coastal resource use.

However, the formal concept of comprehensive, integrated conservation and development of coastal margins has only surfaced over the last twenty years. It has been during that time that demands made of littoral areas and their reserves has increased considerably. The establishment of provisions for Exclusive Economic Zones by the United Nations Convention of the Law of the Sea in December 1982 (Blake, 1987) and the development of advanced technologies for the exploitation of the coastal environment appears to have led to a strong increase in interest in these areas among coastal states. This is particularly so with respect to a developing South West Pacific (SWP) island nation such as the Solomon Islands, where the bountiful resources of coastal lands and surrounding seas have long been essential to the economic, social and cultural prosperity of the region. The coastal zone has been the primary focus of life and economic activities. Their culture has been shaped around the coastal zone and that region continues to be a key element of cultural expression today.

At present, SWP island developing countries are experiencing strong development thrusts based chiefly on tourism, mariculture and extractive enterprises. They are also

used as nodes for international air and sea transportation, as bases for satellite tracking networks, military bases and as dumping sites for industrial and nuclear wastes. There is an increased demand placed upon local resources generated by rising affluence and expectations among rapidly growing island populations. The stresses and pressures of rapid population growth, unrestrained development and modern technology are partly responsible for the decline of the environmental quality of island systems and their littoral zones, and for competition and conflict among traditional and prospective users in the coastal zone.

In the face of this development, concern over the future of the coastal land and marine environment ultimately focuses on the ability to control the impact of human activities on coastal resources. Since Lord Byron's time, control of the coastal environment still has not progressed past the shoreline, but the mark of ruin has. In an attempt to change this, consideration must be given to the institutions, policies and programs through which the power of decision making in the coastal area is exercised. In the case of the Solomon Islands, there has been an omission of coastal environmental resource values in what little planning and development strategies have taken place.

The knowledge that the coastal zone contains such heavily used, valuable, sensitive and threatened resources that it needs to receive special planning and management considerations has already been accepted throughout most economically developed countries. The incorporation of environmental criteria in institutions, policies and programs which deal with the coastal zone has resulted in the formulation of coastal management programs.

The basic objective of coastal management is to ensure a level and type of development of an area and its resource which is consistent with the continuing productivity and vitality of the natural systems upon which the productivity of the area is based (United Nations, 1982). The types of problems faced by coastal management are

encountered throughout the economies of most countries, and are not exclusive to the coastal zone. However, coastal management assumes its importance to the Solomon Islands because of the unusual productivity of its coastal ecosystems and because of the potentially extensive and growing use of these areas for settlement, agriculture, trade, industry and recreation.

1.1 Axes of Coastal Management Concern

Industrialisation has brought prosperity to the economies of most developed countries. Along with industrialisation has come the urbanisation of the population, much of it concentrated in metropolitan areas along the coast lines and lake shores. In the United States for example, over 60% of the population live in coastal areas.

Economic development is not without costs to the environment. Industry, transportation and energy production seek waterfront locations in competition with residential development and its inevitable demands for recreational facilities. To satisfy development pressures in the coastal zone, wetlands have been filled, sand dunes levelled, band barrier beaches crowded with holiday homes and resorts; and shorefronts have been polluted by municipal and industrial effluents and surface drainage (Heikoff, 1977). Offshore drilling for oil and refining and transportation of petroleum products pose constant threats to the coastal environment. This can be illustrated by the following excerpts taken from news reports on CBC radio :

> "...the local people are dumbstruck by the tragedy. Their lives depend on their fishing and their power to attract tourists. For them the Imoco Cadez has brought economic chaos and a violently polluted environment ..."
> "...from New Jersey to Rhode Island, no one knows where it's coming from, but hypodermic needles, viles of blood and other medical waste, some testing positive for AIDS and hepatitis, are still washing in from the ocean ..."
> "... the Exxon Valdez ... went aground ... its belly ripped open. Out poured millions of litres of black crude. It spread ... over hundreds of square kilometres within hours ..."
> "... environmentalists predict that unless significant penalties are placed on industrial polluters in an effort to clean up the St. Lawrence seaway, the

Beluga whale population will be gone by the end of the century..." (Suzuki, 1989).

Societies worldwide are no longer ready to accept these types of environmental costs, as it is becoming more evident that the long term existence of the coastal environment is being destroyed out of proportion to the short term economic advantages derived from resource exploitation.

Figure 1.1 shows the main axes of coastal management concern. Using these axes, it is possible to derive all possible combinations of the three 'products' society can technically produce, as represented by the surface XYZ. Points outside the surface are not attainable given the particular economic, social and resource potential of a given society and points inside the surface indicate full potential has not yet been realised.

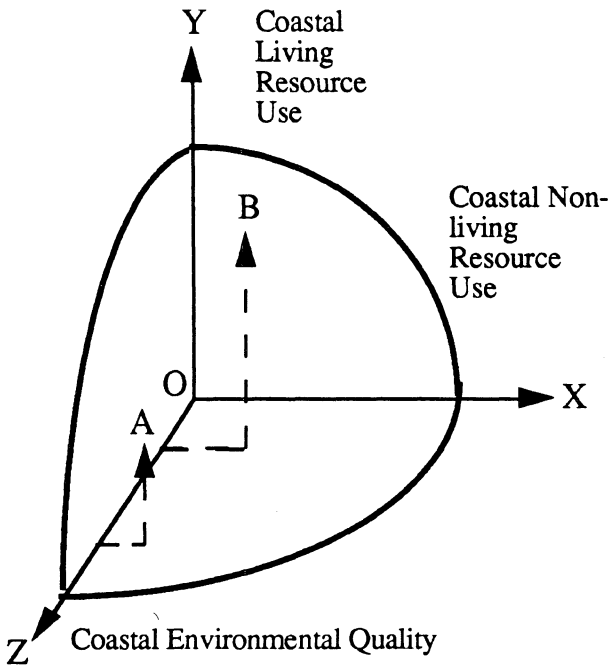


Figure 1.1 Axes of coastal management concern.

Depending on the socio-economic and institutional circumstances of a coastal nation or state, its position on the surface will vary. For example, two communities may have the same technical production possibilities and therefore both use the same surface level indicated by XYZ. One may have a strong lobby group advocating environmental conservation policy (point A), whereas the other community may have a long tradition of fishing, represented by point B. It is also possible to show that a policy statement such as maximising economic efficiency and effectiveness as well as maximising environmental quality is not feasible. At point Z coastal environmental quality is maximised, but at this point a coastal nation would use no resources and would produce nothing.

Over the last century, coastal nations have been moving towards the surface OYX. Exploitation of both living and non-living resources has been at the expense of the long term vitality of the coastal environment, seriously depleting the natural stocks of coastal resources. Nations have begun to realise that environmental quality is an economic 'commodity' which is as equally important to society's well being as the resources utilised in the coastal zone.

Figure 1.1 shows that one product cannot be increased without a decrease in capacity in the other two areas. In effect, there must be a trade off. Therefore, if a conscious decision to optimise coastal industry and development is made, capital, technological development, labour, and scientific research that would have normally be used in the unregulated exploitation of coastal resources, could be diverted to improved conservation and controlled use of habitats within the coastal zone. In this sense, coastal management is not a debate between 'exploitation only' on one side and 'conservation only' on the other. It is more concerned with informed decision making and the allocation of finite resources according to a set of goals that will solve the problems faced by all sides concerned.

1.2 Pacific Awakening

The major concern of the 'global community' in the 1980s has been the development of peoples and nations through national and international aid action. A basic challenge to a developing SWP island country is to improve the well being of its population through the judicious use of resources. In the changing political atmosphere of the SWP, where most countries are now autonomous politically, where external and internal pressures on resources are increasing quickly and where present theories and strategies for development seem to be inadequate, the task of ensuring the continued well-being of their coastal zones is difficult and complex.

A report (Dahl and Baumgart, 1982) commissioned by the South Pacific Regional Environmental Program (SPREP) emphasises this point. Clearly the SWP is no longer the paradise depicted on tourist posters; however nor is it the polluted Mediterranean (yet!). The country reports collectively showed that in coastal areas:

(1) 60% of South Pacific Commission countries had significant soil erosion problems;

(2) more than 50% were concerned with environmental impact of sand and gravel extraction and other mining activity;

(3) 60% had water shortages and pollution problems;

(4) 70% experienced substantial loss of forest area;

(5) 65% had endangered species and nature conservation problems;

(6) over 50% had serious conflicts between land use and land tenure, given the limited land area available on many islands;

(7) over-fishing and mangrove management posed serious difficulties in over half of the countries;

(8) three quarters suffered from significant pollution of coral reef areas;

(9) 90% had difficulties disposing of liquid wastes without causing pollution;

(10) 60% had unsatisfactory means for disposing of solid wastes;

(11) toxic chemicals such as pesticides, to which small islands are particularly vulnerable, were a worry for the majority of the region;

(12) radioactivity was a special case because the long continuing use of islands in the region for nuclear weapons tests and the dumping of nuclear wastes had made this a major political issue;

(13) 60% of the governments were concerned with population growth relative to the carrying capacity of their islands.

Clearly there is an obvious concern for environmental quality by governments throughout the region. The need therefore, is for preventive and remedial measures to be taken before the environmental decline is irreversible. This opportunity had not been available to most other countries. In 1971, a study carried out by Englander (Englander, 1971) outlined problems in managing the United States coastal area. To use a well known euphemism, the "development horse had bolted" in the U.S. coastal zone. As a remedy, the Coastal Zone Management Act (1972) provided some hurdles but the horse is still at full gallop. SWP island countries still have an option to keep on the track of sustainable development. Coastal Zone Integrated Resource Management (CZIRM) in the Solomon Islands is needed, but will only succeed if it is part of regional cooperation in resolving pressing and potential environmental problems. However, to wait for regional efforts would be impractical. As with all projects, enactment takes time and Pacific island time is slower than most. The Solomon Islands is in a position to be an example for other South Pacific Commission countries to follow.

1.3 Solomon Islands - Overview

> ...from the air the first impression of the Solomons is one of colour, of mountain green island sprawling against the shifting blue of the sea. Sandy beaches disappear among a confusion of palm trees. Canoes scud gently across tranquil bays, protected from the white-capped waves by coral reefs. Within the reefs are some of the last unspoiled and virtually unknown areas of the world...
>
> (Kent, 1972)

1.3.1 Area and Population

The Solomon Islands constitute a scattered archipelago of mountainous islands and low lying coral atolls which extend over approximately 1400 km in the southwest Pacific Ocean between latitudes 5 degrees and 13 degrees South and longitudes 155 degrees and 168 degrees East. The islands form part of a Melanesian chain of archipelagoes in the western Pacific, neighbouring groups being Vanuatu, New Caledonia and Fiji to the southeast and Papua New Guinea to the northwest (Figure 1.2). Six large islands — Choiseul, New Georgia, Santa Isabel, Guadalcanal, Malaita, and San Cristobel — account for most of the country's land area of 29 785 km^2. The islands are typical of much of the Melanesian chain, comprising steep, thickly rain forested mountain ranges intersected by deep ravines containing rivers (E.I.U., 1988). There are few alluvial plans, the major agricultural areas being on Guadalcanal.

The country is divided into eight provinces with populations ranging from 10 000 to 60 000. The three most densely inhabited provinces of Malaita, Western, and Guadalcanal contain two-thirds of the total population of 285 796 people as of the November 1986 census (Mayr, 1988). The capital city of Honiara, itself a province, has a population growth rate twice that of the national average of 3.5% due to urban drift of wage earners and dependents (E.I.U., 1988). About 92% of the population are Melanesian, 4% are Polynesian and there are approximately 1000 Europeans. Within this

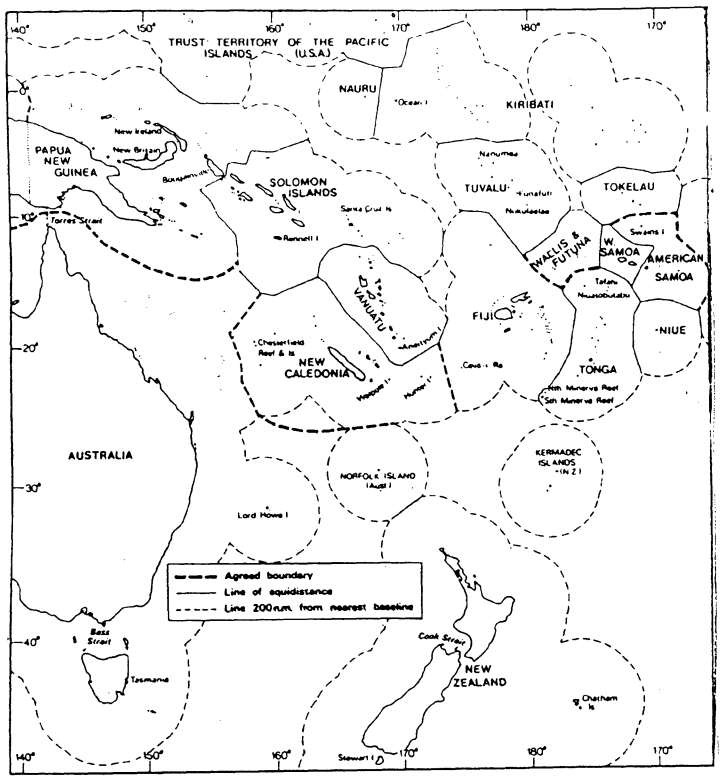


Figure 1.2 Map of Solomon Islands.

seeming homogeneity there is considerable divergence in terms of language. There are 87 vernacular languages and hundreds of dialects (The Courier, 1987). While English is the official language, Pidgin English is the most effective lingua franca.

1.3.2 Society

Most of the population reside in small, widely dispersed settlements along the coasts. Approximately 60% of the people live in localities with fewer than 100 inhabitants and more than 80% in localities with fewer than 200. Village life is life in the Solomon Islands; the capital Honiara, with a population of over 30 000 is seen as somewhat of an aberration by a majority of the population. Village life rests on four pillars.

(1) The practise of subsistence economy — nine out of ten households in the Solomon Islands are engaged in subsistence food production (fishing and farming) to some extent which contributes 40% to the gross domestic product (World Bank, 1980).

(2) Wantokism — a customary social system that is based on the recognition of bonds of kinship with important obligations extending beyond the immediate family group or clan. Its influence on the whole social structure is very strong even in urban areas.

(3) Big man system — generally egalitarian doctrine emphasising acquired rather than inherited status (Bennett, 1987).

(4) Customary tenure — over 90% of all land and extensive areas of coastal waters are under customary tenure. Ownership, management and use of land and coastal waters is made immensely complex by this traditional system.

These four pillars have made for a stable and democratic society and have in fact been complimentary to the modern imported concepts of Christianity and parliamentary democracy. However, they have also been barriers to economic progress. The complex question of land and littoral zone ownership has made larger scale and intensive resource development and management difficult. The wontok system is a barrier to individual enterprise and initiative. Provision of infrastructure and social services are costly given the scattered population base.

1.3.3 Classifying the Solomon Islands

In the realm of international politics, the Solomon Islands has lacked the combination of sufficient area, population, resources and political leverage to count for very much. To a large degree, islands of the SWP basin (including Australia) have been seen by continental powers as marginally valuable frontier outposts to be used and exploited with little regard for indigenous inhabitants. Islands of all types — oceanic,

coastal or archipelagos, colonial, territorial or independent — have historically been treated in a callous manner and frequently been administered with general disregard for democratic theory, political morality, social ethics and more recently environmental principles and standards (Clark, 1985). The Solomon Islands as an example, has since 1567 been under the colonial rule (at differing times) of Spain, Germany, Japan, the U.S. and Great Britain and only gained independence from Great Britain in 1978 because the colonial government was too great a financial burden for the declining British economy.

Therefore, this is a time of change for the Solomon Islands as in the rest of SWP island countries. In the last twenty years, insular isolation has been broken by jet air services, containerised cargo technology, tourism, satellite communication and television. Also there has been a significant rise in the level of interest among foreign companies and bilateral and international aid agencies. It is a time of caution, however, as uncontrolled development could have severe repercussions on island systems.

What makes islands different from continents? Natural scientists (Douglas, 1969; Simberhoff, 1974; and Wace, 1978) are in agreement that islands can be described by a number of common ecological attributes. Put in lay terms, the Solomon Islands can be said to be characterised by the following:

(1) relatively isolated, rare and endemic habitats;

(2) limited in size;

(3) restricted and finite natural resources;

(4) limited in organic biological diversity;

(5) tendency towards climatic standardisation;

(6) high vulnerability and instability when isolation is broken;

(7) ecological fragility.

The Regional Ecosystem survey of the South Pacific Area (Dahl, 1980) seems to strengthen these findings. Island ecosystems have a diversity and specificity to present

unique challenges for their preservation and management. Dahl found that there are about 2000 types of ecosystems or biomes in 20 distinct bio-geographic areas of the region. Each island, therefore, has unique features that make it difficult to implement detailed management plans or approaches devised for other jurisdictions.

Similar investigations by social scientists (UNCTAD, 1974; Wace, 1980; Dolman, 1982) showed that islands such as Solomon Islands have the following socio-economic characteristics:

(1) more dependence on foreign trade than large countries and less influence on the terms in which the trade is carried on;

(2) a narrow range of resources, so the economies are quite specialised;

(3) heavily dependent on one or more large foreign country;

(4) dependent for key services on external institutions such as universities regional training facilities, banking and marketing arrangements;

(5) a narrow range of local skills and specific difficulty in matching local skills with jobs;

(6) difficulties in providing some infrastructure services as there may be costly dis-economies of scale in the provision of such services;

(7) a small G.D.P. and so local industrial development to replace imports may face special difficulties.

Most small countries, not just islands, face these problems, but they are particularly relevant to the Solomon Islands, as the statistics shown graphically in Figure 1.3 reveal. Basically, the Solomon Islands have an economic dependence, whereby external circumstances and decisions have as great an impact on their internal system as internal circumstances and decisions on the internal system. This situation is particularly applicable when consideration is given to the implementation of a coastal management program.

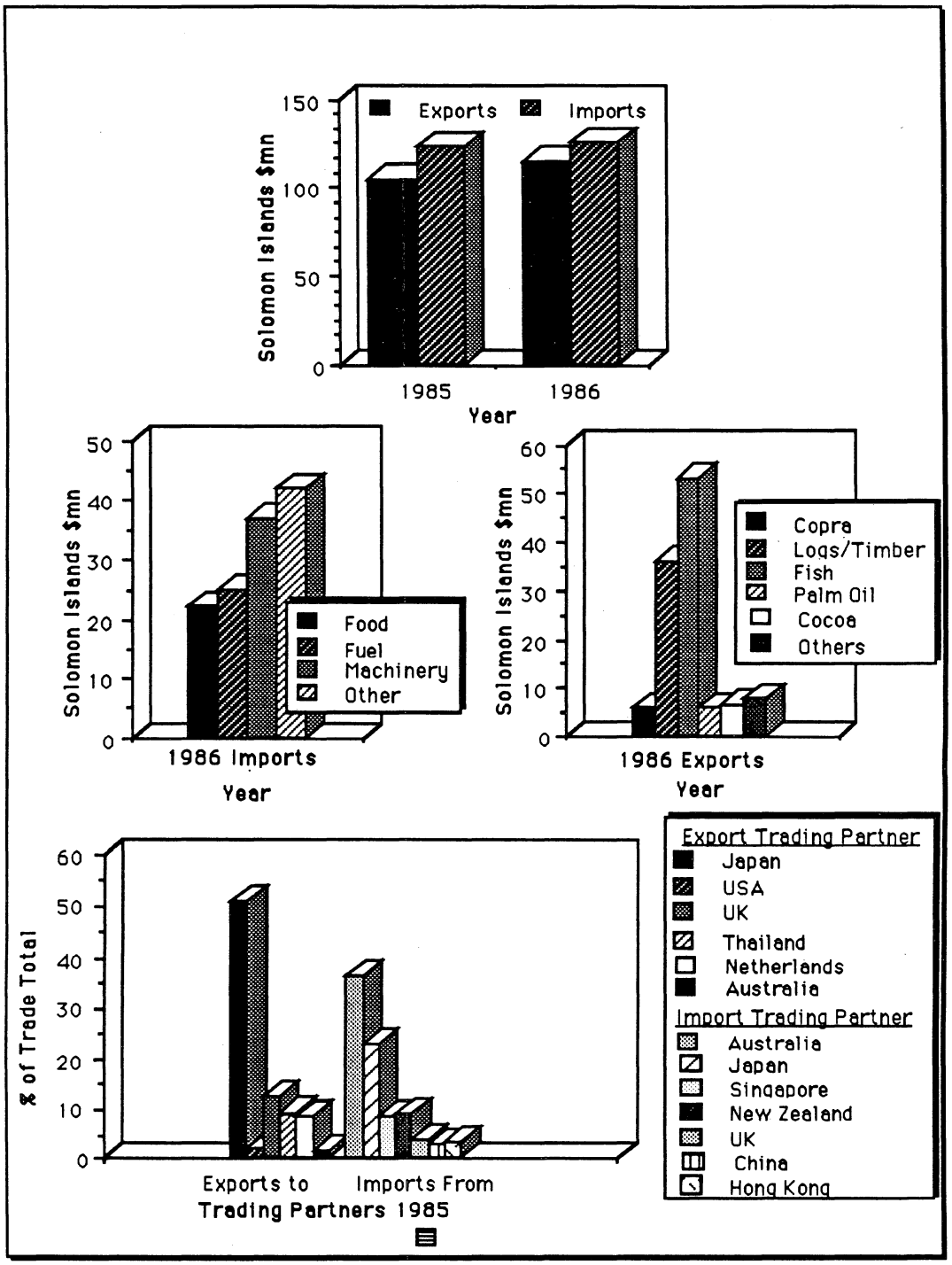


Figure 1.3 Foreign trade statistics — Solomon Islands (after EIU [1987- 88]).

There are other obvious yet often overlooked characteristics that are unique to archipelagoes like the Solomon Islands (as compared to a continental country) and so have a significant bearing on the formation of a coastal management strategy:

(1) They have a completely circumferential coastal zone.

(2) They have a favourably disproportionate ratio of the size of the EEZ to the island land mass (see Chapter Five).

(3) Archipelagoes have no real internal land transportation infrastructure to link the nation and so they must use sea and air.

(4) Small islands do not have areas that are significantly distant from the ocean to escape its influence. The jurisdictional control of a coastal zone management program therefore may not be the same as for a continental country (e.g. local in U.S.A. may equal national in S.I.).

Islands in the SWP are not just different from continents in scale, but in kind as well. They differ from continental models ecologically, socially and economically. It has been a lack of knowledge of and/or sensitivity to these differences that has seen many continental sponsored projects fail in the SWP.

1.3.4 Island Vulnerability

Remoteness of SWP island countries has not guaranteed freedom from the effects of pollution, offshore oil spills, inappropriate engineering projects, tourism, ocean dumping of chemical wastes or the destruction of habitats and indigenous species by introduced species. There has been a western perception of emptiness and remoteness directly affecting the SWP region for over 200 years. In the Solomons, land that was not cultivated or visibly occupied and so assumed empty was declared waste and vacant and became the property of the colonial government. Littoral areas were simply taken in the

name of the Crown. The consequences of this early legal invisibility remain today (Reynold, 1987).

In the 1950s the emptiness of the Pacific proved a new attraction to nuclear powers. In 1954, the Bravo hydrogen bomb was tested at Bikini by the United States and the people of Rongelap and nearby islands were blanketed by pulverised radioactive coral dust. The French continue to test today. The emptiness of the islands and surrounding ocean has been justification for storage and dumping of nuclear wastes. The 1980s saw the importance of the area for the space shuttle (Easter Island was levelled for an emergency landing runway); satellite tracking (all Soviet satellites pass over an area northeast of New Zealand); and for a superport at Palau (Micronesia) for large scale Middle East oil shipment and processing (Baines, 1980).

As shown by the above examples, the indigenous people are vulnerable to a donar country's development wishes because of reliance on the colonial or former colonial governments for economic aid to sustain imported infrastructure and services their island economies could not. The SWP may be empty, but not useless to developed countries.

Decisions that effect island coastal zones have in instances been made thousands of kilometres away. For example, intense advertisement or promotion in continental countries has created tourism booms for insular systems that have been swept along in a development thrust aimed at a neighbouring island, archipelago or broad region. Consequently, without advance notice or contingency planning, the islands have been left vulnerable and overwhelmed. This is shown by the advent of regular international jet air service between the United States, Australia and New Zealand which has had significant repercussions on SWP island stop over/refuelling points such as Raratonga in the Cook Islands, Vitu Levu in Fiji and Pago Pago in American Samoa. They now face another economic crisis, as jets over fly the Islands.

The above discussion was intended to show that there are many different sources, kinds and levels of island vulnerability; however they can be categorised into three separate but interrelated groups: environmental, social, and economic. Because economic vulnerability is the basis of most environmental and social problems it will be discussed further.

An indication of economic vulnerability is the level of island dependency that is induced by external driving variables such as multinational initiatives, bilateral and multilateral foreign aid, satellite communications and international energy and commodity pricing programs (Dahl, 1980). In 1981, Michael Hamnet of the East-West Centre Pacific Island Development Program in Hawaii put together an effective ranking strategy to establish an index of island economic vulnerability (Hamnet, 1981).

Hamnett observed that although numerous island areas had achieved independence in the past twenty years, all had remained economically dependent on external capital, commodity export markets and outside sources of costly energy and development assistance. Using available information, he came up with six major components of a economic vulnerability index:

(1) foreign aid dependency;

(2) diversity of imports;

(3) food substitutability (could the island feed itself);

(4) dependency on imported fuel;

(5) fiscal integrity (cost of government operations against GDP);

(6) political constraints (external ties affecting internal decision making).

The results in Figure 1.4 show that the Solomon Islands is in a relatively strong position. Ward (1989) points out that countries of Melanesia have size and resources of a much higher magnitude than those of Polynesia and Micronesia. Still very much reliant on foreign aid programs and resources (in 1986 the foreign debt stood at SI$170mn

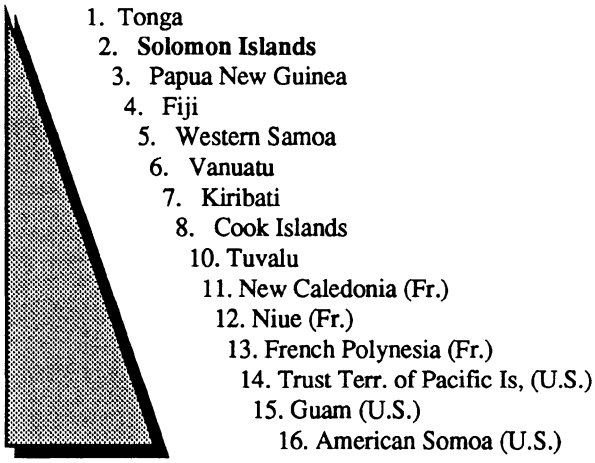


Figure 1.4 Composite index of economic vulnerability: least to most vulnerable (after Hamnet et al., [1981]).

[ETU, 1987]), the Solomon Islands has started to exert some political strength, however, as shown in an incident known as the Jeannette Diana dispute (The Courier, 1987). Political and economic interests obliged the Solomon Islanders to stand up to the U.S.A. government and to suffer the economic consequences for more than two years in defense of their fishing interests. Actions such as this to regain a degree of self reliance are however quite rare, and with most island countries politically impossible because of their high economic vulnerability to one or several aid sources. It is clear from Figure 1.4 that the U.S. government policies in the region have produced adverse affects. For independent small island states, the real issue is the nature and degree of dependence because they really only have independence of limited choice within a dependent system (Kavaliku, 1980). The mere transfer of funds and technical expertise to island areas to face development problems is not a solution, as it may unintentionally generate increased dependency and therefore vulnerability to the donor country or organisation. As the Solomon Islands Permanent Secretary, Leonard Maenu points out with regard to past development projects, "... project implementation and continuation depends on foreign individuals. When those individuals leave, the project falters..." (The Courier, 1987). It

would seem assistance strategies need to have local self reliance as a targeted objective rather than as an assumed resultant.

Foreign aid and technical assistance is inevitably essential to the implementation of a coastal management program in the Solomon Islands. A measure of success of a program should be judged by how well foreign assistance is used in local initiatives to mitigate island economic, technical, social and environmental vulnerability while developing coastal resources. In essence, this is the real meaning of sustainable development in the coastal zone.

1.4 Coastal Management and the Surveying Profession

There is no doubt that the management and development of coastal zone resources is a matter of great economic and social importance to developing island countries. It also presents a challenge to the surveying profession as potentially the greatest growth point in the future demand for our services, to which the profession must respond. Surveyors have the potential to break totally new ground and fulfill the role of coastal managers. The management function consists of securing the optimal use of coastal resources to meet the social and economic needs of a developing island country and can be broken into a number of responsibilities. This list of functions is by no means complete and is not in any order of priority. It includes :

- organising and acquiring of bathymetric, topographic and environmental data; the provision and maintenance of this coastal zone related information and the distribution and use of information products in both graphical and textual form such as navigational charts, nautical publications, topographical/bathymetric maps and environmental impact reports;
- organising and delineating of baselines and the boundaries of coastal management areas, territorial seas, EEZs and continental shelves;

- organising and coordinating of resource surveys within those zones;
- evaluation and research of the methodologies and viability of resource exploitation;
- market research of development possibilities including related economic considerations, the potential resource exploiters (national or international based) and the potential sources and types of development finance;
- establishing policies for the management and harvesting of coastal zone living resource stocks;
- consideration of opportunities for the development of energy from waters, currents or winds ;
- establishment of criteria for environmental protection and conservation policies;
- defining development objectives and evolving management policies to achieve those objectives;
- organising the provision of infrastructure (onshore and offshore) to service the requirement of resource development;
- establishment of mechanisms to facilitate the exploration and exploitation of non-living, non-renewable coastal resources; the overseeing and monitoring of those activities and the collection of revenue of those activities;
- coordination of the various coastal resource development programs;
- liaison with those organisations concerned with maritime affairs and with authorities that are responsible for land areas which may be affected by or give affect to the development of coastal zone resources;
- liaison with the agencies responsible for coastal management of neighbouring countries or countries that may have a special interest, and in appropriate cases undertaking joint ventures with them.

No single discipline could embrace all of these functions. Specialist tasks will undoubtedly be undertaken by surveyors (of all types), geologists, oceanographers,

engineers, fisheries experts, financial experts and lawyers. Several key functions however are analogous to those already performed in land based operations by surveyors. This involvement in so many aspects of resource management equips the surveyor for the overall management function, the role of coastal manager, a role that involves pulling all these disciplines together in the implementation of coastal management programs. It is a natural extension to the functions surveyors perform in a land only environment.

The surveying profession has traditionally been involved in the translation of land and water related data into information used in the everyday transaction of a society. It has been a huge responsibility on our part. Coastal management poses an even larger responsibility, the order of which has been compared to the impact that the microchip has had on everyday lives over the last twenty years. The surveyor's task will be to remind the unprofessional; the politicians, the entrepreneurs and the 'aid' agencies, of the consequences, in detail and in particular, of their misguided policies and projects in the Pacific region. The surveyor cannot be silent and must use the benefits of a multidisciplined background to bring the others down to earth, and water.

1.5 Thesis Objectives

Coastal Management is a term quite unfamiliar to the majority of the surveying engineering profession, as to date the professions involvement in coastal management programs has been limited or indirect. It could be argued that this has been to the detriment of most programs that have been implemented and currently are not achieving their stated goals.

In this thesis coastal management is viewed from a new perspective which has been defined as Coastal Zone Integrated Resource Management (CZIRM). This term was chosen because it implies that management is restricted to a defined zone and concerned as a priority with environmentally sustainable utilisation of coastal resources. It is the word

integration however, that provides the mechanism to accomplish the above statement and therefore gives rise to the main objective of this thesis: the development of an appropriate coastal management strategy for a developing SWP island country with special emphasis given to information management problems.

1.6 Thesis Structure

To achieve the stated objective, this thesis is structured in the following manner. This chapter has provided an introduction to the coastal zone and the importance of its management in an environmentally sustainable fashion. Chapter Two introduces the concepts of coastal management and makes the case for the need for coastal zone integrated resource management (CZIRM). Various coastal programs which now exist in the United States and the South Pacific are assessed as to their application to the Solomon Islands in Chapter Three. In Chapter Four the information management needs are considered, as well as appropriate method for assessing requirements for technology to fulfill those needs. Chapter Five examines the institutional framework necessary for an effective CZIRM program in the Solomon Islands. Chapter Six shows the design for implementing a CZIRM program. Finally, conclusions and recommendations are made in Chapter Seven.

CHAPTER TWO

THE CONCEPTS OF COASTAL MANAGEMENT

Because coastal management is a broad and new field, search of current literature has found no general agreement on the use or meaning of fundamental terms or phrases. A number of terms are used interchangeably to describe the activities of managing a coastal region, area, zone, use or resource. These include coastal zone management, coastal management, coastal resource management, coastal sectoral management and coastal zone resource management. In general, they are not carefully defined and the following is an attempt to review some of the key concepts, distinguish differences and clarify some important terms.

2.1 Coastal States and Nations

The terms coastal state or nation refer to any government authority with jurisdictional powers over a given area that includes a coastline. In this definition, the words nation or state are interchangeable. It was noted by Sorensen (1984) that taking into account the combination of 136 sovereign coastal nations, up to 40 semi-sovereign states, national sub-units which are constitutionally autonomous and the many regional authorities, on a world wide basis the potential exists for creation of well over 250 distinct coastal management programs.

2.2 Coastal Zone, Coastal Area and Estuarine Zone

The coastal zone is the critical interface between the land, the sea and the atmosphere. The inter-relationships among these three domains are the basis of coastal management. The coastal zone can be defined as a linear strip of land and adjacent ocean space (water and submerged lands) that are mutually inter-dependent (Ketchum, 1972).

The coastal zone is biologically unique and of critical importance to man because it is the area where production, consumption and energy exchange processes are most intense. It is conceded that although it is generally understood what is meant by the term coastal zone, it is not possible to place boundaries to this general understanding, either seaward or landward. The Coastal Zone Workshop in Woods Hole in 1972 decided on a lengthy working definition which combined demographic ecological, geographical and functional considerations: It defined the coastal zone as:

> ... the bank of dry land and adjacent ocean space (water and submerged land) in which land ecology and use directly affect ocean space ecology, and vice versa... Functionally, it is the broad interface between land and water where production, consumption and exchange processes occur at high rates of intensity. Ecologically, it is an area of dynamic biogeochemical activity but with limited capacity of supporting various forms of human use. Geographically, the landward boundary of the coastal zone is necessarily vague... the seaward boundary has been defined as the extent to which mans [sic] land based activities have measurable influence on the chemistry of the water or on the ecology of marine life ... (Ketchum, 1972).

A more complete look at placing boundaries in the coastal zone is provided in Chapter 5.

Another term that has been used on occasion interchangeably with coastal zone is estuarine zone, however it is a distinct term which is used in connection with or forms part of a definition of the coastal zone. An estuarine zone has been defined as:

> ...an environmental system consisting of an estuary and those transitional areas which are consistently influenced or affected by water from an estuary such as, but not limited to, salt marshes, coastal and inter-tidal areas, bays, harbours, lagoons, inshore waters; and channels, and the term "estuary" means all or part of a navigable or interstate river or stream or other body of water having unimpaired natural connection with the open sea and within which the sea water is measurably diluted with fresh water derived from land drainage ... (U.S. Department of Interior, 1970).

Basically, the differences between coastal and estuarine zones amount to the designation of the outer extent of land and ocean boundaries, with the coastal zone being of greater area (Figure 2.1). Also, the coastal zone may not include an estuarine

environment, given the unusual situation of no major river drainage systems in a particular management location.

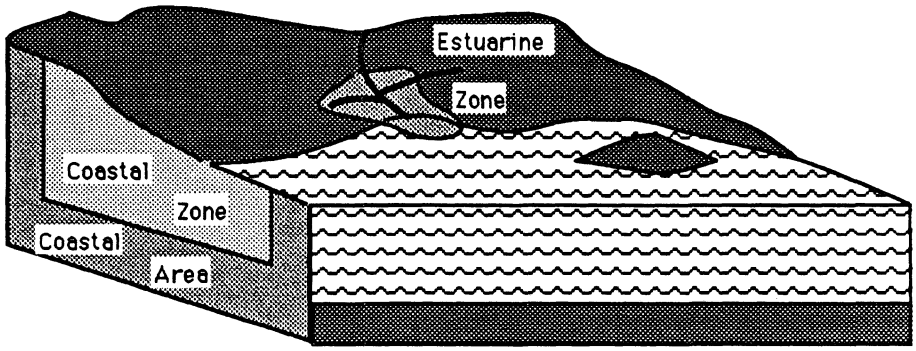


Figure 2.1 Spatial depiction of coastal delimiters.

Fundamental to the interpretation of both terms is the attempt to delimit inland and seaward boundaries for the zones. Although for both terms the borders have not been fixed definitely, the definitions imply that it is both possible and desirable. With this in mind, the term coastal area finds a meaning which alludes to the term coastal zone, but significantly refers to geographic space that has not been defined as a zone. In other words, in a coastal areas the inland and ocean boundaries have not necessarily been set or even approximated. Use of the term indicates that a coastal nation or state has recognised that a distinct transitional environment of significant importance exists between the ocean and land domains, but its precise boundaries have not been defined.

2.3 Coastal Resources

The coastal zone is a major resource, or multitude of resources, of immense value for commercial, recreational and aesthetic reasons. Coastal resources are not as widely scattered spatially as other natural resources, but they may be used by populations scattered across continental land masses. A coastal resource is usually defined as a natural, often renewable commodity, the existence of which depends on the coast. The

commodity's 'value' to society is appreciably enhanced by its location within the coastal zone (Armstrong et al., 1981). The word value is not restricted to its fiscal definition, although in most cases of coastal resource exploitation this is often the highest priority. In this thesis cultural and social physical features are considered as a resource.

Coastal resources can be divided into six major groups as shown in Figure 2.2 . Products of industry or agriculture are considered resources if they achieve substantial production advantages from conditions associated with their coastal location. Also included in the figure are what may be termed coastal environments, such as mangroves, estuaries and coral reefs. Coastal environments are natural and man-made physical conditions that are either specific to the coastal zone (e.g. estuaries) or whose characteristic is significantly determined by its coastal location (e.g. fishing village) (Sorensen et al., 1984). The quality and condition of the coastal environment relates directly to the resources' potential for utilisation.

Use of coastal resources refers to their utilisation for economic, aesthetic, recreational, scientific or educational purposes. These uses may be consumptive (e.g. mining) or non-consumptive (e.g. sailing). A more important concern for coastal zone managers is the difference between coastal dependent and non-dependent uses and their compatibility of uses within a mutually used area. For example, fishing, aquaculture, port facilities and oil extraction are all coastal resource dependent uses, however aquaculture is unlikely to co-exist with port facilities and so the two would be classed as incompatible uses. Table 2.1 points out some of the positive and negative relationships among sectors.

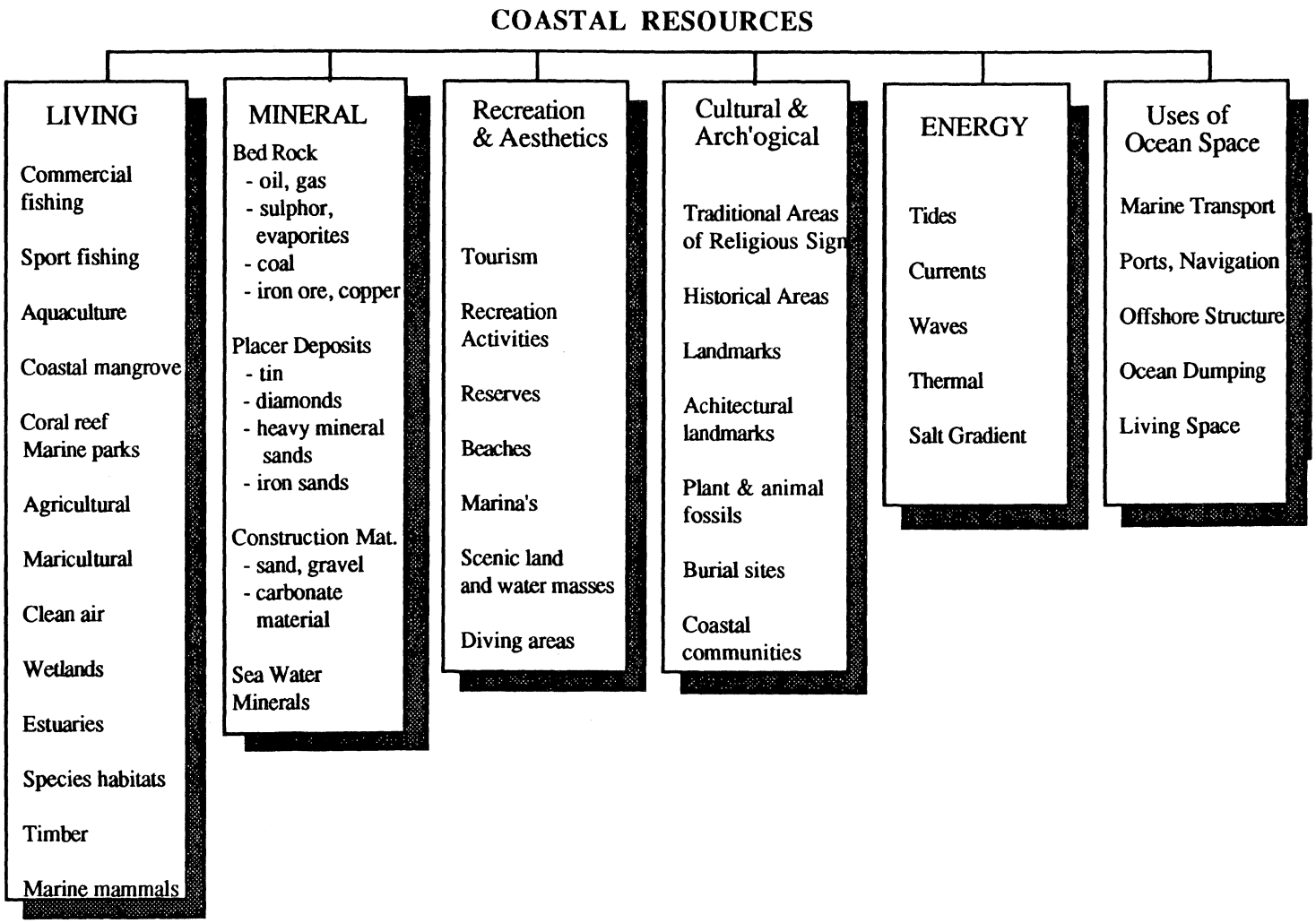


Figure 2.2 Resources of the coastal zone.

Table 2.1 Positive and negative relationships among resource sectors.

SECTORS RECEIVING IMPACTS	SECTORS GENERATING POSITIVE AND NEGATIVE IMPACTS				
	PORTS & SHIPPING	TRANSPORTATION	PUBLIC UTILITIES	TOURISM	FISHERIES
FISHERIES +	HARBOURS AND PROCESSING FACILITIES.	ROADS AND RAILROADS TO MOVE PRODUCTS	ALLOWS LOCAL PROCESSING.	SPORTS FISHING	REGULATION SAFETY IMPROVEMENT
FISHERIES −	SHIP POLLUTION WETLAND FILL	WETLAND FILL ESTUARY FRAGMENTATION	POLLUTION, DEVELOPMENT MADE EASIER	LOSS OF FISH NURSARIES.	OVERFISHING DEPLETED RESOURCES
TOURISM +	PASSENGER LINER FACILTIES	AIRPORTS AND ROADS TO TOURIST AREAS	INFRASTRUCTURE FOR TOURISM DEVELOPMENT	PROMOTES IMPROVEMENT AND ADDITION TO FACILITIES	CONSERVATION OF HABITAT AREAS VITALTO BOTH INDUSTRIES
TOURISM −	SHIP POLLUTION WASHED ON BEACHES AND IN SWIMMING AREAS	ALLOWS FURTHER DEVELOPMENT OF SCENIC AREAS	ENCROACHMENT OF URBAN DEVELOPMENT	DISTROYS REASON FOR BEING UNIQUE TOURIST DESTINATION	AIR AND WATER POLLUTION FROM FISH PROCESSING AND BOATS
HEALTH & SAFETY +	Docks And Channels Enabling Evacuation In Event Of Storm Or Flooding	ROADS AND BRIDGES	RETAINING WALLS AND DAMS TO REDUCE OR ELIMINATE HAZARDS	IMPROVEMENT IN MEDICAL FACILITIES	INCREASES FOOD SUPPLY
HEALTH & SAFETY −	POLLUTION PORT DEVELOPMENT IN HAZARDOUS AREAS	ALLOWS DEVELOPMENT IN HAZARDOUS AREAS	STIMULATES URBAN DEVELOPMENT IN HAZARD AREAS	OVERLOAD ON PUBLIC SERVICES DEVELOPMENT IN HAZARD AREAS	WATER POLLUTION

Resource use up until now has primarily been dependent on economic benefit derived from a particular use. For example, even though a estuarine system is vital to the continued replenishment of fish stocks, and a residential development is a non-dependent coastal resource use, short term economic utility of the space occupied by the estuarine system dictates that it be destroyed for housing estates. It should be noted that a developing country will be most concerned with those resources of direct economic (and to a lesser extent social) value.

2.4 Coastal Management

Coastal management refers to any process initiated for the purposes of utilising or conserving a coastal resource or environment. It is meant to be a very broad and all encompassing term, intended to include all types of 'organised' intervention in coastal

areas. This intervention may be a single independent action or a series of successive, related measures, the end result being the allocation of scarce coastal resources.

Historically, from an industry perspective, the economic theory of markets as well as the concept of private property facilitated business approaches to coastal management. Put simply, the goal of firms that used coastal resources was to increase profits. This was the only standard against which they judged whether coastal management was successful or not. From a governmental viewpoint, the use of the term implied a few basic requirements:

(1) A coastal area has been distinguished as a geographic area apart from but between the ocean domain and the terrestrial domain although it may have no legal jurisdiction.

(2) The resources and/or environments being managed defined the geographic extent of the area.

(3) Management usually addressed one resource or environment, rather than several types of resources or environments.

Coastal management in government was again directed towards efficient resource use from an economic perspective which meant profits, more jobs and importantly a larger tax base for the government. Allocations were made by degrees and the sum impact of a series of smaller decisions was not considered. Unfortunately, important vestiges of both these approaches by the public and private sector still exist and affect management schemes in the coastal area today. Under the term coastal management are a number of more specific terms which will be defined.

2.5 Coastal Sectoral Management or Planning

As the term suggests, coastal sectoral management or planning indicates single use or narrowly targeted schemes. It is used most commonly to describe a socio-economic

development area. Sectoral planning is usually undertaken for ports, fisheries, tourism, oil and gas development and wildlife management. Sectoral management results from governmental specialisation in a distinct policy area formed by coastal uses. Table 2.2 indicates that the coastal zone of a nation can include between fifteen and twenty-five sectoral management areas, each having a separate government agency responsible for each division (Sorensen et al., 1984). The coastal zone specific sectors have planning boundaries that usually stay within the outer limits of the coastal zone, whereas sectors with direct impact may only impact on the coastal zone in part.

Table 2.2 Sectoral management and planning in the coastal zone.

Coastal Zone Specific Sectors	Sectors With Direct Impact
NATIONAL DEFENSE	AGRICULTURE/AQUACULTURE
PORT & HARBOUR DEVELOPMENT	FORESTRY
SHIPPING AND NAVIGATION	FISH AND WILDLIFE MANAGEMENT
RECREATIONAL BOATING	PARKS AND RECREATION
COMMERCIAL	EDUCATION
MARICULTURE	PUBLIC HEALTH
TOURISM	HOUSING
MARINE & COASTAL RESEARCH	WATER POLLUTION CONTROL
SHORELINE EROSION	WATER SUPPLY
	TRANSPORTATION
	FLOOD CONTROL
	OIL & GAS DEVELOPMENT
	MINING
	INDUSTRIAL DEVELOPMENT
	ENERGY GENERATION

2.6 Coastal Zone Management

Coastal Zone Management as a phrase and as a concept has been in use predominantly since the enactment of the United States Coastal Zone Management Act of 1972 (CZMA). The CZMA was a response in part to the findings of a Committee Report which accompanied section S3507 of the CZMA. The report acknowledged primarily that:

(1) There is a national interest in the effective management, beneficial use, protection and development of the coastal zone.

(2) The coastal zone is rich in a variety of natural, commercial, recreational, industrial and aesthetic resources of immediate and potential value to the present and future well being of a nation.

(3) The increasing and competing demands upon the lands and waters of the coastal zone occasioned by population growth and economic development, recreation, extraction of mineral resources and fossil fuels, transportation and navigation, waste disposal ,and harvesting of fish, shellfish and other living marine resources, have resulted in the loss of living marine resources, wildlife, nutrient-rich areas, permanent and adverse changes to ecological systems, shoreline erosion and decreasing open space for public use.

(4) The coastal zone and the fish, shellfish, other living marine resources, and wildlife therein are ecologically fragile and consequently extremely vulnerable to destruction by human alterations.

(5) Important ecological, cultural, historical and aesthetic values in the coastal zone which are essential to the well-being of all citizens are being irretrievably damaged or lost.

(6) Special natural and scenic characteristics are being damaged by ill planned development that threatens these values.

(7) In light of competing demands and the urgent need to protect and to give high priority to natural systems in the coastal zone, present institutional arrangements for planning and regulating land and water uses are inadequate.

These problems were not being addressed by the independent piecemeal action being undertaken by 'coastal management' programs and it was felt by the federal government that the uncoordinated allocation process led to abuses of coastal resources

that were not in the nation's interest. The CZMA set into motion efforts to 'manage' this area in a way that would be more socially beneficial than was the case previously.

Since 1972, coastal zone management has received steadily growing attention from public policy makers and the academic field. However it is not a term that has been well defined due to the fact all three words are subject to differing interpretation. Management is usually seen as a series of activities consciously designed to formulate and attain a particular objective. It is a process that begins with goal setting and extends through the function of research, planning, development, regulations and financing. Given that there is an understanding of what constitutes the meaning of coastal zone, then coastal zone management can typically be recognised as resolving conflicts among many coastal uses and determining the most appropriate use of coastal resources. It refers to the management of two or more coastal sectors within a defined zone. As well, the management program has institutional recognition through either implementation and maintenance by one government department or a number of government and private agencies. Coastal zone management involves :

(1) developing an understanding of the coastal zone as a system;

(2) using this knowledge to create a plan for its best use;

(3) implementing and enforcing that plan (Ketchum, 1972).

2.7 Coastal Resources Management

Coastal resource management is a term that has been used as an alternative to coastal zone management, due to the fact that it accentuates the concepts of environmental planning and resource management. This is attractive to environmental policy makers who view the coastal environment as constituting a complex ecosystem that is an important and unique resource that must be maintained for the benefit and use of future

generations (O'Riordan, 1981). By taking this view, coastal resource management can be defined as:

> ... a process of decision making whereby resources are allocated over space and time, according to the needs, aspirations and desires of man within the framework of his technological inventiveness, his political and social institutions, and his legal and administrative arrangements. Resource management should be visualised as conscious process of decision making involving judgments, preferences and commitments, whereby certain desired resource outputs are sought from various perceived resource combinations through the choice among various managerial, technical and administrative alternatives ... Resource management involves strategies of action, involving computation of tactics and methods, and variety of objectives. The emphasis is upon flexibility and the minimisation of long term environmental catastrophes, while maximising net social welfare over time. The allocation process is dominated neither by the market place nor by the quasi-political forum, but by a combination of social, cultural, economic, and institutional processes that strive for the best solution, but which inevitably must be compromised... (O'Riordan, 1971).

This complex definition attempts to encompass many of the practices involved in management. Importantly it points out that a viable solution must be a compromise among many sometimes conflicting human processes. The concept of multiple use of the coastal zone is inherent in the above definition. Multiple use means that an effort is made to accommodate two or more uses within the same area. It involves asking a few simple questions: Is the use being considered compatible with other uses? If so, which ones, how can they be combined, where and what limits must be placed on each to ensure that they do not conflict with one another or the environment in the long run?

The focus on resources management reflects the growing awareness among developing nations that renewable natural resources constitute foundation blocks needed to support the construction of economic and social development programs.

2.8 Coastal Zone Integrated Resource Management

Figure 2.3 shows the above three strategies for management of resources in the coastal area. The diagram represents a generalised classification of the approaches

according to objectives, resources addressed and the initiator of the program. The majority of projects carried out in the coastal zone today are multiple objective, single resource, private initiated coastal resource management projects such as natural gas or oil drilling. It can be seen that there is a missing block in the foundation strategies, comprising of a target joint public/private initiated program in which multiple objectives are realised with respect to the utilisation of a number of coastal resources.

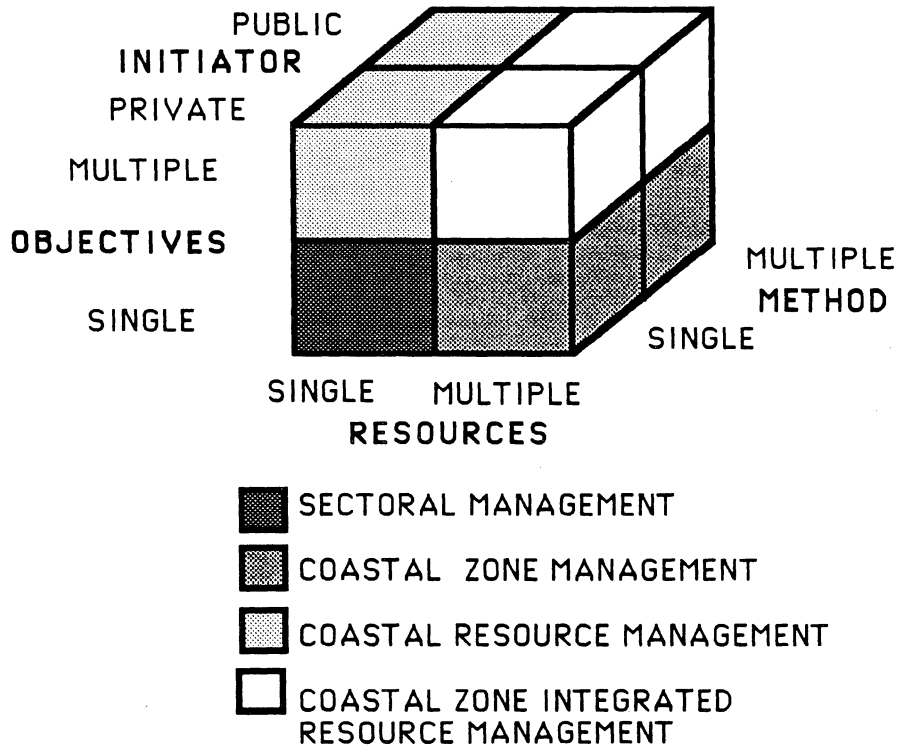


Figure 2.3 Coastal management approaches.

This type of approach has been alluded to in reference literature under numerous synonyms with varying complexities of definition. However, for the purpose of this thesis, this strategy is termed as coastal zone integrated resource management (CZIRM). The term coastal zone integrated resource management is defined as:

> The process of mitigating environmental, social, economic and technical conflicts within a defined coastal zone through a strategic, interactive and multi- disciplined approach in which consensual objectives are realised in the environmentally sustainable utilisation of coastal resources.

Lang (1986) points out that most resource planners probably accept, without much argument, the need to take more integrated approaches to their work. Less apparent are the conditions necessitating integration, which would explain why a successful attempt at integrated planning in the coastal zone is not documented.

2.8.1 Need for CZIRM

The need for a different approach to coastal management is simple; present strategies cannot cope with the intense resource use and associated environmentally detrimental change. With respect to change in coastal areas:

> ...the greater the change, the greater the need for planning, otherwise precedents of the past could guide the future; but the greater the degree of uncertainty, the greater the likelihood that plans right today will be wrong tomorrow... (Trist, 1968).

Coastal management has traditionally been a discipline of reducing uncertainties about an area little understood with inadequate information resources. This uncertainty has been categorised in relation to:

(1) The operating environment — creating a demand for more research, better data, improved predictions and new tools for risk assessment.

(2) Policy values to be applied with respect to ends and means — need for better policy guidance and innovative solutions.

(3) Concern about actions of others in related fields — requires collaboration and coordination (Lang and Amour, 1980; Friend et al., 1974).

For coastal managers, this presents both opportunity and dilemma because the above uncertainties that generate the need for better planning also make planning more difficult without an adequate information platform.

Governments, in response to these uncertainties, have traditionally differentiated departments into new divisions and branches. The problems of this diversification can be identified in Canada simply by reading a national newspaper:

(1) insufficient and unconsolidated knowledge about coastal resource (e.g. does the Canadian government really know the extent of the fish stocks on the Grand Banks of Newfoundland);

(2) no census on how or even whether, resources should be used or managed among departments (e.g. the regulation of the aquaculture industry in New Brunswick);

(3) the absence of clear and specific policy statements (e.g. PCB disposal in Québec);

(4) no clarity about the means to achieve desired ends (e.g. the cleanup of the St. Lawrence seaway.);

(5) program solutions being fragmented in responsibility and especially accountability among many agencies, each with some autonomy (the management of the Great Lakes is a prime example);

(6) numerous interest groups expecting to be consulted and made part of the decision process, but regularly being ignored resulting in protests delays or even blocking plans (e.g. Greenpeace activities in all environment causes).

In most cases, differentiation of responsibility in the coastal zone has always been treated from two distinct perspectives; the environmental content and the institutional content (McLaughlin, 1987). The environmental context has been concerned with alleviating environmental damage, but not really altering the patterns of political and economic power (O'Riordan, 1981). The institutional aspect has traditionally focused on various aspects of group, collective or social action that influence and control use of coastal resources. The need to bring these two perspectives together under a CZIRM approach is shown by Figure 2.4.

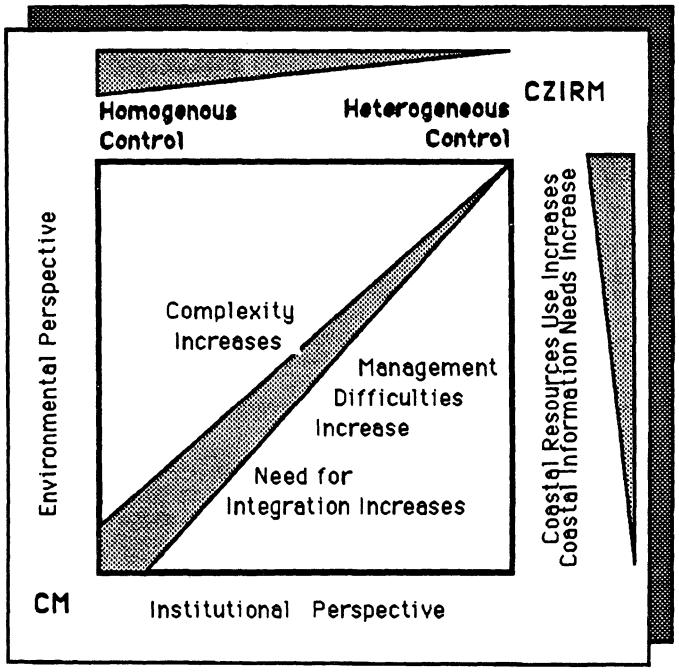


Figure 2.4 Need for CZIRM — Integration of environmental and institutional perspectives (after McLaughlin [1987]).

As stated in the Brundtland Report (1987), " ... separate policies and issues can no longer cope effectively with these interlocked issues." CZIRM attempts to link both physically and philosophically the differentiated government departments and private agencies (internally as well as externally) with concern for the coastal zone.

2.8.2 Classifying CZIRM - Comprehensive vs. Incremental

CZIRM incorporates the best of incremental and comprehensive planning. Incremental management as described by Lindblom (1959) is a narrowly based, opportunistic style of management (Table 2.3). Its value is in quick action, flexibility and the focus on producing agreement among a select group of decision makers. However, it has serious deficiencies for coastal management.

Table 2.3 Assessment of incremental approaches to coastal management.

Pro.	Con.
• opportunistic • fast implementation • flexible • small implementation cost • programs & support develop simultaneously • focus on course action agreement • narrowly focused information base	• action treats symptoms not cause • longterm effects overlooked • real needs overlooked • oriented to status quo not innovative • omits interests without power • promises only limited results; full resource benefit not realised

Incremental planning is short sighted, usually seeking immediate economic gain at the expense of the environment or the long term sustainability of the exploited resource. Unfortunately, in developing countries it is a pragmatic approach to immediate socio-economic problems. However for sound coastal management of sustainable resources to be achieved, incremental methods operating within a bounded rationality are not good enough on their own.

Comprehensive or rational coastal management is the planning process upon which CRM and CZM programs have usually been based. In the ideal form of this process, the management authority:

(1) establishes a goal or set of goals;

(2) considers the full range of means to achieve them;

(3) evaluates all consequences of each alternative;

(4) selects the most appropriate alternative with regard to goals;

(5) implements the course of action.

Such planning is necessarily comprehensive since rational decision require full consideration of all alternatives and their consequences (Forester, 1984). As in all planning the espoused ideals differ somewhat from the theory in use. Managers are forced to rely on less information, be constrained in alternatives, have shortened time horizons and introduce other innovations to make rationality and comprehensiveness manageable. Comprehensive management works best when uncertainty is least; the need is well defined; strong concensus exists on ends and means; the impacts of program actions are known and the 'lead agency' has a high degree of control. However, it is the opposite set of conditions that apply to coastal zones in developing countries in the SWP :

> Decisions on ... resource development are made in an atmosphere of greater uncertainty ... the uncertainty is almost always greater in a developing country because of the weaker information base. As a result many projects in the developing world have unexpected and usually undesirable outcomes ... economically, socially and environmentally ... (Morgan, 1989)

It is under this type of condition that comprehensive coastal management programs are passed on from developed to developing country. Typically in a developing country

(1) objectives are unclear, therefore it is nearly impossible to devise methods to achieve them;

(2) because the methods are ill-structured, problems can only be defined during rather than prior to implementation;

(3) when knowledge is incomplete, information insufficient and there are constraints to research, the search for options and evaluation of impacts are very restricted.

Rational decision making for the good of all concerned is then severely compromised (Table 2.4). Comprehensive coastal management therefore becomes less appropriate. It is apparent that CZIRM lies somewhere between the incremental 'dive

straight in' and the comprehensive 'get your toes wet first' approaches. However, it needs to be more defined as the 'in-between' is still quite a gulf.

Table 2.4 Assessment of comprehensive approaches to coastal management.

Pro.	Con.
• extensive information base • multi-action • all actions justifiable • supportive measures combined • interrelated measures considered together • options thoroughly evaluated • commitment to program	• extensive information gathering • technical bias • inflexible • high cost • broad base difficult to implement • politically risky

2.8.3 Strategic Focus towards Integration

Integration can occur at any or all three levels of managerial activity, the strategic planning process, the management control process and the operational control process (Figure 2.5). CZIRM is primarily focussed firstly at the strategic level, in an attempt to cope with the highly complex, constantly changing coastal zone environment. A strategy can be seen as a proposed sequence of mutually reinforcing actions directed towards an interrelated set of objectives (Forester, 1984). A strategy indicates not only what is wanted and the means of achieving it but also the step-by-step procedure to get there and courses of action if things change. A generalised flow diagram for strategic planning is illustrated in Figure 2.6. A strategic focus to CZIRM is necessary as management must address situations where agencies only have partial control and interest.

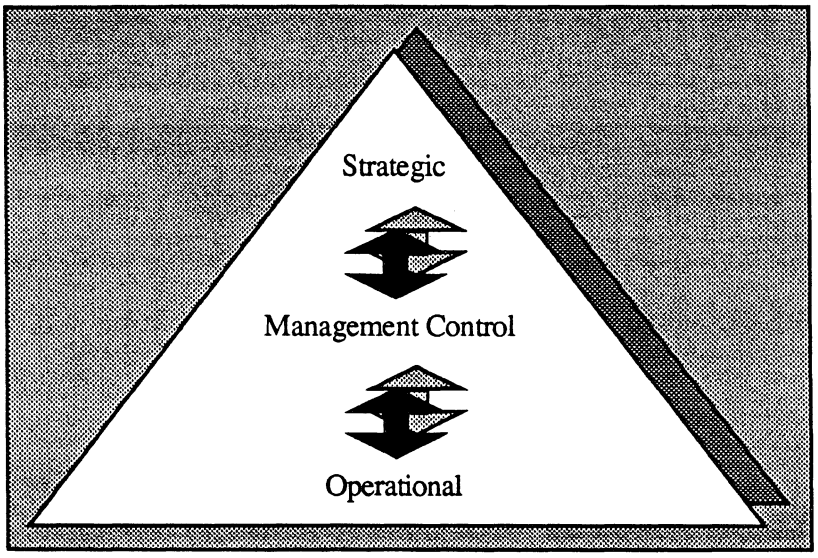


Figure 2.5 Categories of managerial activity.

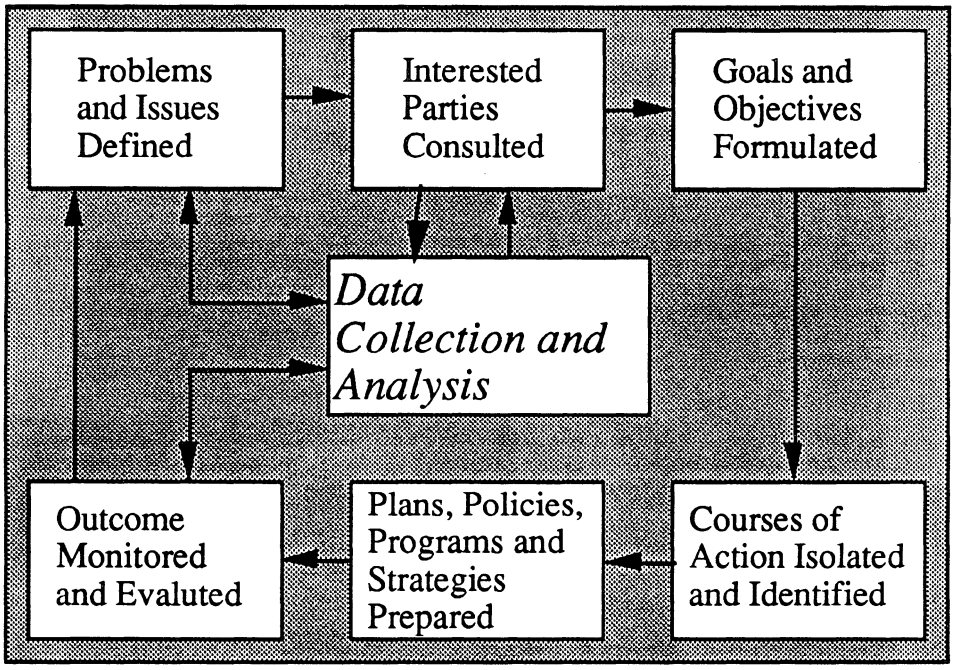


Figure 2.6 Generalised strategic planning process.

A strategic approach to CZIRM in the Solomon Islands has three main positive characteristics:

a. Action orientated
   - implementation can occur at each stage of the planning process.
   - implementation will occur while planning is still going on.

b. Focussed quickly
   - uses scoping techniques to narrow options quickly so lengthy, costly data collection is avoided.
   - values of multi-disciplined experts used to guide data collection.

c. Flexible & adaptive
   - able to meet changes in environmental, economic, social, technical and political circumstances.

Although the key components of strategic planning are similar to comprehensive planning there are some important differences (Friend et al., 1974; Steiner, 1979; Radford, 1980).

(1) Comprehensive planning usually begins by assembling a comprehensive data base and rarely addresses institutional and/or organisational factors. A strategic approach to coastal management would bring a fresh perspective because intra and inter organisation problems are major concerns.

(2) The scope of comprehensive planning is quite wide, with goals not always matching economic, human and technical resources available, particularly in developing countries. For this reason, strategic planning is selective and focussed enough to allow viable solutions to problems.

(3) Comprehensive planning goals are often vague. By design, strategic planning devises clearly expressed mission statements.

(4) Strategic management is especially applicable when the environment to be managed is dynamic. Strategic plans attempt to anticipate future conditions and provide contingency plans for them. It relies on continuous monitoring, regular review and strong collaboration of concerned parties. Comprehensive plans tend to be considerably less dynamic.

(5) Strategic planning is proactive. By this, it is meant that management is systemically looking for opportunities and threats and come up with better ways of meeting stated objectives. Comprehensive management is mostly preactive, where future programs are primarily based on what has happened in the past; or reactive, to put right what already has serious problems.

(6) Strategic management programs are planned according to an agency's resources, with economic considerations primary to plan objectives. In comprehensive planning, it is not unusual for budgeting to be completely separate to planning, therefore increasing the possibility of projects being left incomplete due to lack of funds.

(7) Strategic managers rely to a greater degree on heuristically derived knowledge and to a lesser degree on interpretation of complex data analysis than comprehensive managers.

2.8.4 Interaction

A CZIRM approach to coastal management requires interaction among resource users, government and private agencies to facilitate information gathering and retrieval, issue consensus and implementation of strategies that are feasible and acceptable to all. Interaction is made necessary by at least five factors (Clark and Cummings, 1981):

(1) dispersed information;

(2) spatial proximity of resources;

(3) conflict in resource use;

(4) need for public support;

(5) need for organisational and institutional change.

Interaction includes information — feedback, consultation, collaboration and negotiation. It assumes that open participative processes within these practices leads to better decisions. Restricting interaction in coastal planning processes would not be in the long term interest of the program, especially given a complex circumstance with multiple user interests. Affected interests (e.g. Greenpeace) may delay or block a plan through legal avenues, political clout or media coverage when interaction is absent.

Fundamentally, an interactive aspect to CZIRM is a significant departure from comprehensive planning. Comprehensive planning tends to be dominated by a technical/analytical style where management is seen as neutral and detached. By contrast an interactive management engages directly with interested parties to build support and consensus. Lobbyists within the land information management industry have at times resorted to this style to ensure system implementation.

Interaction is particularly important to the successful implementation of a CZIRM program in the Solomon Islands. After decades of colonial rule where indigenous interests have largely been ignored, there is still a resentment to government dictate. Interaction allows for open, participative processes, leading to better decision supported by coastal resource users.

2.8.5 Multiple Perspective Approach

Most resource management programs, sponsored by aid agencies such as The World Bank, CIDA and USAID are dominated by a perspective termed as technical rationality (Lang, 1986). This type of approach is characterised by the assumptions that:

(1) all problems can be solved by a technology 'fix';

(2) complex problems can be reduced into manageable components, and then recombined into a now 'understandable' larger problem;

(3) there is total objectivity on the part of the analyst;

(4) quantification of information preserves objectivity and more accurately depicts reality;

(5) there is only one optimal solution (Miller, 1983).

Unfortunately, this type of approach to many developmental aid programs has resulted in an unintentional disregard for the root problems that the program could possibly have alleviated. At times, a fundamentally technical approach has created more problems than have been solved, as can be attested to by the Washington State CZM program (Magoon, 1978). In coastal management issues which usually involve complex, uncertain, unstable, unique and conflicting circumstances, a single perspective is insufficient for CZIRM.

To this end, CZIRM requires the accommodation of three other major perspectives. A technical view enables the choice of appropriate tools used in assembling a sound base of information. An institutional perspective uncovers organisational barriers, constraints and opportunities which pose the major obstacle to CZIRM. The social perspective looks at it as a means of enhancing positive social (and economic) change.

In this sense, integration involves relating coastal management to management of other social concerns such as housing, job opportunities and transportation. The political aspect is essential to the implementation of a program and is very closely tied in to the social perspective. Politicians are put in power primarily through public vote but also to a certain extent through economic support from sections of industry. CZIRM is presently very politically feasible due to an intensifying public pressure globally and to 'greening' of

industry. It is both an impetus for and an instrument of change. The continued operation of a program is dependent on political support.

Multiple perspectives comprise an essential feature of CZIRM, fundamental to the meaning of integration. A multiple perspectives approach is also basic to the holistic thinking that coastal resource issues require enlarging the capacity of planners, decision makers, managers and stakeholders to see resources and their use from all points of view (Mitchell, 1986).

2.8.6 Feasibility

There is justifiable doubt as to whether any one type of approach would be adequate to address the broad range of circumstances encountered in coastal management. An integrated approach however is an innovative attempt to have a management program which is strategic, interactive and open to multiple perspectives.

A CZIRM program is a reaction against narrowly based incremental decision making which pervade most projects in coastal areas. However, it is not equivalent to conventional comprehensive planning which, in an attempt to be rational and all-encompassing, tends to produce plans that are long in coming, exceedingly broad in scope, overly technical in orientation, and often incapable of securing the agreement of the many interests involved. A review of Organisation of American States Department of Regional Development activities stated this to the effect that:

> ... comprehensive regional development plans are too expensive, too time consuming, too detailed, and therefore too fragile to withstand the realities of development. They may be intellectually satisfying to create, but rarely are they converted to reality ... on the other hand, a simple grouping of projects is no basis for planned development ... (O.A.S.D.R.D, 1986).

CZIRM represents a change in management organisation from an existing approach that is familiar and institutionalised. (In most cases the existing program is 'non-existent.') This transition has the positive aspect that integration is not a significant

departure from what currently occurs informally or on a limited basis. Unlike other new approaches, CZIRM is primarily a streamlining of what already exists, to adequately meet the present circumstances. A CZIRM program combines a mix of incremental and comprehensive management approaches. By making coastal management strategic, it pays explicit attention to the institutional and organisational environments, focusing analysis early, leaning planning towards action and making it an ongoing process. By imposing an interactive aspect to the technical analysis from the very beginning of the project, focus and consensus is achieved among program managers as well as those affected by its implementation. It therefore facilitates the gathering and transfer of information in and among concerned apartments. Finally, through multiple perspectives, the economic and technical orientation of conventional planning is alleviated to accommodate alternative action in the solution.

CHAPTER THREE

APPROACHES TO COASTAL MANAGEMENT

Coastal management programs have been implemented (in some cases it would seem in name only) in many countries of the world. Common to all programs is the foundation management strategy. It is the purpose in this chapter to classify and evaluate some these programs as they are enacted in different geographic, social and economic jurisdictions throughout the United States of America and the SWP. An evaluation of their effectiveness and appropriateness to the Solomon Islands is then carried out. Even though most of the programs are a derivative of the United States Coastal Zone Management Act (1972) [CZMA], their strategic goals are quite different.

3.1 Emergence of CZM Policy in the United States

By 1950, it was becoming evident to the United States public that major sections of the coastal zone were being seriously affected by significant resource use conflicts. It appeared existing government programs offered little prospect of solving these problems. Although traditionally the federal government had been the dominant force in the development of coastal areas, it was the state governments along with private organisations that made the first attempts to relieve growing use conflicts among the various coastal sectors of the United States. The first significant modern state legislative action directed to an explicit coastal management problem was undertaken by the Texas State Government in 1959, where an open beaches law designed to confirm public ownership of and unimpeded access to beaches was passed (Bradley and Armstrong, 1972). In 1960, citizens of the San Fransisco area organised a Save-the-Bay Association to oppose further infilling of San Fransisco Bay and to promote regulation of additional

development of its shores (Schoop, 1971). This action resulted in the creation of the San Fransisco Bay Conservation and Development Program (1965), which became a model for later state wide CZM activities. New Jersey began limited public acquisition of coastal wetlands in 1961 and Massachusetts passed two 'landmark' wetlands preservation laws in 1963 and 1965 (Bradley and Armstrong, 1972).

State government approaches to coastal management differed from region to region. Atlantic maritime states emphasised preservation of wetlands. Pacific states focussed on improving public access to beaches and controlling shoreland development. The Gulf Coast states concentrated on methods for the allocation of exploitation rights, with little regard for the effects of over-development. In the Great Lakes, land zoning and erosion control were the foremost issues. Settlement of land claims by native Alaskans against the federal government overshadowed coastal management issues until the discovery of oil and gas in 1969 (Berry, 1975). In Hawaii, concern for coastal management was incorporated within pressure for state wide land use planning.

State government responses to coastal resource conflicts led eventually to proposals for national coastal zone management. Although some states had already developed self-contained programs without federal guidance, many programs were limited in conception and execution. Concerns were piecemeal and emphases uneven (Heikoff, 1977). None were comprehensive in geographic scope or management concept. A bewildering array of coordination problems developed among local, state and federal governments and between neighbouring jurisdictions which lacked a common framework of goals, criteria, procedures or plans (U.S. CMSE&RM, 1969). Against this background, federal administrators and legislators laid the ground work for a broad national coastal policy.

3.1.1 CZMA (1972) and Implementation

The Coastal Zone Management Act (1972) established for the first time a formal partnership between federal and state governments in the coastal zone. It dealt with the process of developing a program through the establishment of various elements which a coastal state must examine in structuring its management program. These elements included:

(1) delimiting coastal zone boundaries;

(2) determination of permissible uses and priorities among uses;

(3) defining types of manpower and programs required;

(4) the identification of areas requiring special attention;

(5) coordination of agencies and units of government at all levels with responsibility for and concerned with coastal areas.

The Act focussed on processes and left the substance of the management program for the individual states to define. This was in response to the varied physical and social nature of the nation's 88 000 mile (140 000 km) shoreline, which would have made a single national plan difficult (U.S. Department of Commerce, 1978). Secondly, some states had already implemented aspects of a general coastal zone management program. Thirdly, the decentralised planning that the Act proposed was seen as promoting the widely desired goal of increased public participation in government decision making (Mitchell, 1982). Also, in 1972 there was strong opposition to further federal involvement in land use controls by state and local governments and interest groups. Finally and probably most importantly, the Submerged Lands Act of 1953 recognised that the states owned the submerged lands and resources of the territorial sea, making it both politically and legally difficult to force states to implement coastal zone programs.

The system of government in the United States is a three tier one which divides responsibilities between national government, state government and thousands of local units of government such as cities and counties. The federal role was carefully restricted to encouraging states (by waving financial 'carrots') to follow the above guidelines outlining what their coastal program must contain.

Four years after its passage, the CZMA was significantly amended due to the difficulties involved in regulating private property development, which was a source of conflict in many states, and the provision of public access to beaches and other public areas (SEC. 305[b][7] CZMA,1976). Other amendments were concerned with the siting of energy facilities, shoreline erosion and financial support for research and technical assistance.

The CZMA was envisaged as a unified and comprehensive approach to the resolution to coastal problems, but it did not long survive in that form. Existing legislation was amended and new legislation was enacted that directly affected coastal management and the operation of the Act, including :

- The National Flood Insurance Program (1968, 1973)
- The Deepwater Port Act (1974)
- Marine Protection, Research and Sanctuaries Act of 1972 (1977)
- Water Pollution and Control Act (1972)
- U.S. Fisheries Conservation Management Act (1976)
- Marine Mammal Protection Act
- Endangered Species Act (1973)
- Outer Continental Shelf Act (1953) (1978)
- National Ocean Pollution and Planning Act (1978)
- Water Quality Act of 1987
- Magnuson Fisheries Conservation and Management Act (1983)
- Acid Precipitation Act (1980). (U.S. Dept. of Commerce, 1987).

While the preceding laws and programs were among the more prominent national legislative orders affecting coastal management since 1972, they represent only a fraction of the total federal effort. If state and local initiatives are added, the total amount of direct and indirect effort spent on coastal management is huge.

As of January 1989, of the thirty-six U.S. states and territories eligible under the CZMA, thirty had an approved program. As to the administrative strategy of each program the solutions adopted varied greatly, ranging from programs that are primarily sectoral in structure to programs that essentially rely on shoreline exclusion as a solution to coastal problems.

3.1.2 State Profiles

An examination of the programs shows that six distinctive approaches can be identified in the coastal management programs which states have adopted:

(1) Sectoral planning;

(2) Special areas and regional plans;

(3) Shoreline exclusion;

(4) Critical area protection;

(5) Acquisition programs;

(6) Land use planning.

These six approaches were further classified as comprehensive or incremental management programs. None were found to be functionally integrated management programs.

3.1.2.1 Sectoral Planning and the Maine CMP

The Maine Coastal Management Program (MeCMP) was approved in 1978. The program consisted of thirteen core laws administered by state and local governments within a boundary that consisted of all coastal towns and townships on tidal waters, all coastal islands, seaward to the extent of the State's territorial limit. Maine adopted a traditional sectoral planning approach, combining forecasting and implementation for capital investment, land use planning, and infrastructure needs for specific sectors of the state economy (Heikoff, 1977). Those sectors with greatest economic relevance were

given priority in the program: fisheries, port planning and tourism. Because these sectors have a close dependency on a strong natural resource base, there was some consideration of habitat and environmental quality factors in the program. For example, the MeCMP in conjunction with the National Marine Service under the U.S. Fisheries Conservation and Management Act (1976), prepared fisheries plans for specific species, placing sustainable yield quotas on more commercial valuable species and stimulating the development of under-utilised stocks.

Virtually all major ports in Maine are located in estuaries; therefore attention was given to minimising the further destruction of wetland and productive benthic communities from industrial development and resultant pollution (Ketchum, 1972). Tourism in Maine needed the mix of facility expansion and a relatively unspoiled environment. However, these goals were at once in conflict, as well as in conflict with the other sectors. Rather than alleviate these problem in a coordinated manner, each sector chose to address its concerns individually (OCZM, 1978). Consequently, what happened in Maine was the perpetuation of non-integrated, single purpose programs (Sorensen, 1978).

Sectoral planning is incremental by nature, moving with only small changes from the status quo, although superficial changes within sectors give the appearance of major innovation. For this reason, government institutions have a tendency to make these types of decisions which are easy and Maine was no exception. Sectoral management is probably more commonly used than any other strategy, and the Maine program would be analogous to many programs throughout the world.

However a strong, broad slope sectoral management program could serve as a transition to CZIRM. If a department or agency begins to realise some net benefit from taking wider perspectives to resource management problems, such as the sharing of basic coastal information, the process towards CZIRM would become easier.

3.1.2.2 Special Area/Regional Program Management in San Fransisco

The San Fransisco Bay Conservation and Development Commission (BCDC) was one of the first regional planning bodies with an effective implementation program in the United States. Special area/regional program management refers to incremental programs for land use regulation, economic resource development, environmental management or a combination of these. They are multi-sectoral in nature, but they may concentrate on a single issue. In this case, the agency was created in 1965 in response to citizen and legislative concern over the alarming rate of peripheral filling of San Fransisco Bay and the consequent shrinkage of the Bay's size (Hind, 1987). An interesting point however, was that the program was not approved under the CZMA (1972) until 1977.

The geographic focus of this type of program is typically larger than a single city or county, but less than an entire state or province. The BCDC was comprised of a mix of local governments, private agencies and citizens. The BCDC's primary mandate was to approve or deny projects that would fill bay bottoms or block public access within 100 ft (30.5 m) of the shore, a policy which still exists today. The BCDC has virtually halted the net loss of wetland acreage and bay bottoms, yet has permitted construction of needed port and airport facilities along the Bay shores by obtaining mitigation in the form of wetland restoration (Swanson, 1975).

A regional level of planning offers a number of advantages for coastal management. At a regional level, problems confronting whole estuaries or ecosystems can be addressed. Very often these issues cross a number of jurisdictions and cannot be dealt with effectively without a regional focus. It allows local government authorities and officials with responsibility in various sectors affecting the region to cooperate in resolution of common problems. The failure to fulfill this opportunity often causes a regional program's collapse. By choosing a regional focus, national governments are able

to concentrate on areas with the most pressing problems. If successful the model may be extended or transported to other areas.

A common failure of special area/regional programs such as the BCDC program is that they are predominantly land based and do not explicitly deal with water based issues. The BCDC, for example, has no significant authority to manage Bay fishery resources (Swanson, 1975). Parallel to this is the question of local government autonomy during the creation of a regional planning agency by a state or national level legislative body.

3.1.2.3 Shoreline Exclusion and Restriction - Puerto Rico and Oregon Coastal Zone Management Programs

Shoreline exclusion and restriction refers to regulatory programs which specifically prohibit or significantly limit certain uses within a strip or band in the coastal zone. The areas subject to shoreline restriction are typically landward from the high water mark (HWM), due to national government control of lands below the HWM. This type of management strategy usually arises because of blockage of public access to coastal areas, degradation of views due to development or erosion of shorelines. Shoreline exclusion programs are coast wide and therefore do not carry any special designation of uniqueness of particular areas. There are essentially two types of shoreland exclusion programs:

(1) Fixed upland and offshore dimensions are used in Puerto Rico's 1978 coastal zone management legislation defining the boundaries and management regime (U.S. Department of Commerce, 1978). The fifty metres above mean high water is called the Public Zone which cannot be owned or controlled by any private concern. The next 150 m landward is the Restricted Zone where development is tightly controlled by three national government agencies with coastal management interests.

(2) A program to protect resources and guarantee public access in the state of Oregon is an example of the second type of exclusion program, coast wide exclusion based on the configuration of natural features. A state supreme court decision upheld a century old law

requiring that the entire foredune (to the inland line of permanent vegetation) be kept free of construction and fencing to ensure the continued right of access. This restriction also confers the benefit of protecting dune vegetation and associated wildlife (Oregon, 1976).

Shoreline exclusion programs are administratively attractive because they are:

(1) inexpensive;

(2) geographically precise;

(3) offer clear guidance about prohibited areas;

(4) can be tailored to particular natural resources;

(5) enjoy support from inland residents;

(6) provide consistency with specific dimensions;

(7) provide moratorium until a more detailed plan can be provided;

(8) can be used in conjunction with other programs.

For these reasons they are ideal in a developing country situation. However highly developed or urbanised areas sometimes have difficulties implementing exclusion zones, as was the case in Oregon. A program requires strong legislative backing to survive public opposition to exclusion imposition. As well exclusion distance set backs are often not good enough to resolve the issues the strategy was established to resolve (Sorensen et al., 1984)

3.1.2.4 Critical Area Protection and the Massachusetts CZMP

Critical Area Protection (CAP) strategies are enacted by state or national governments to:

(1) conserve or preserve sensitive environments;

(2) prevent development in erosion areas;

(3) restrict development in flood plains.

In case number one, conservation or preservation of sensitive environments could be classed as sectoral management for marine and land wildlife protection. In the second and third cases they are similar to exclusion zones. All three have been implemented in the MCZMP under the Ocean Sanctuary Program, Wetlands Protection Program, and Wetlands Restriction Program (U.S. Department of Commerce, 1989).

Critical area protection (CAP) strategies are significantly different to sectoral and exclusion management strategies in that CAP strategies are a result of an inventory or screening of sights; they are not implemented coast wide and they address the concerns of more than one sector. They are often an intermediate step before the creation of marine parks. To this end, the MCZMP includes twenty seven policies which serve as a guide for both regulatory and non-regulatory authorities in the implementation of a program.

Critical area protection could be used in developing countries as a technique to help the consequences of urbanisation. It enables a concentration of funds and resources on the most threatened or hazardous areas in the coastal zone. The very term 'critical area' alerts decision makers and the public to the need for quick action. However, it is not a complete solution and is often at best a stop gap measure. It is remedial rather than preventative.

3.1.2.5 Acquisition Programs - Massachusetts and Connecticut CZMPs

In this context, acquisition programs are defined as an organised effort over an extended period for systematic land purchase. Acquisition programs have been used in a number of U.S. programs with limited success. Over the first ten years of the Massachusetts CZMP, the state acquired 1230 acres (497 ha) of coastal land at a cost of 30 million dollars. However, this does not take into account the legal and administrative costs of acquiring the land. The Connecticut coastal zone program acquisition strategy has provided only 10.6 linear kilometres of new public access. The major problem both states

have faced is the lack of a sustained flow of funds to use exclusively for land acquisition, proving the strategy for the most part ineffective.

A developing country has an advantage over developed areas in that major portions of the coast line are relatively rural, agricultural or vacant. However, they still face the financial problem of compensation. From a practical point of view, exclusion zones and critical area strategies are far less costly. Developed countries in most cases have no other option to provide public access to areas occupied by private owners.

3.1.2.6 Land Use Planning and the California Coastal Zone Program

Land use planning is aimed at specifying the type, intensity and rate of development in a particular area. Although it has many forms, the most common is often called euclidean zoning, where a single use designation is assigned to each parcel of land. Therefore in theory it is comprehensive in coverage. Variations to euclidean zoning, implemented for sensitive environmental areas have used an overlay zoning technique where special restrictions have been imposed in addition to designating permitted land use (Sorensen et al., 1984).

In California, requirements that all fifty three coastal cities and fifteen coastal counties draw up a Local Coastal Program (LCP) is the basis for the most ambitious of the U.S.C.M. programs with land use planning as its focus (Bodovitch, 1978). Consisting of a land use plan and zoning regulations, a LCP must reflect the state policies on public access, water and marine resources, land environments, new development ports and energy facilities. Within the general framework of coastal resource protection the local governments have discretion over which goals to emphasize. The California Coastal Commission (CCC) designated as the lead agency for program implementation is responsible for reviewing all LCPs to ensure consistency with the California Coastal Act (1976) (Department of Commerce, 1989).

Following approval, local governments are responsible for administration of the land use plan and implementation. However, the Coastal Commission still has 'some' jurisdiction over sensitive habitats and areas adjacent to the shoreline. A state requirement that local governments prepare coastal zone land use plans as practiced in California, is one of the most popular mechanisms used by states to implement CZM programs funded by the U.S. CZMA (1972). This arrangement has been termed as state-local collaborative land use planning (Sorensen, 1978). It has been used in some form in Alaska, Florida, Louisiana, Michigan, Minnesota, North Carolina, and Washington.

Land use planning provides a mechanism to resolve use conflicts arising either along the shoreline or at inland locations affecting the coasts. In this way the detrimental effects of agriculture, development and industry can be addressed in the context of coastal management. When linked with strongly enforced zoning, land use planning provides clear guidance and certainty about future development, both in location and use.

Programs organised on a state-wide (or nation wide) level allow multiple use conflicts to be dealt with in a consistent manner. In the California example, the CCC is the central authority responsible for formulating policies which are adapted to local conditions by local governments. The CCC also has an overseer role to ensure that state (and national) interests are upheld.

Land use planning has been criticised for its somewhat speculative nature (Armstrong and Ryner, 1978). Plans can be only as effective as the zoning ordinances and use restrictions are enforced, thereby relying on the integrity or political will of the government and elected officials responsible for plan implementation. For developing countries, customs and traditional use of land, combined with uncertain land tenure, complicates any effort for clear rational use of coastal land. The development of squatter settlements in most urban areas of developing countries is an example of this. Programs

for land use planning instituted by the state or national level may conflict with local or traditional authority.

To be successful, land use planning requires an extensive information base, covering a wide range of natural resources, characteristic resource use, settlement patterns, institutional, economic and political concerns. The strategy then requires the capability to interpret data meaningfully to be able to develop a single coherent plan. In most developing SWP island countries, both the technical capability or expertise are presently not available internally. What little information that does exist is not adequate to support nationwide land use planning (UNOETB, 1982). In most countries and in the California case, land use planning fails to deal directly with land below HWM or the water column itself.

3.1.3 Evaluation of U.S. Approaches to Coastal Management

The achievements of coastal management since 1972 have received little detailed evaluation. What has been done has been more concerned with process rather than result. This is probably because the CZMA (1972) is really a process for encouraging states to achieve good management, rather than a blueprint for the attainment of shared national goals. Each state's approach to the program was different because of varied problems, goals and geographic situations. Because of limited information about the performance of state programs, what follows here tends to emphasise national evaluation perspectives and their relevance to a developing island country such as the Solomon Islands.

The CZMP can be classed as a success, if eligible state participation is a measuring standard. According to Department of Commerce data, many states have enacted new legislation for implementing the main provisions of their management strategies (U.S. Council, 1979). However it is not known whether the new legislation represented a new direction for coastal states or were just marginal modifications of existing statutes simply

to quality for the federal funding. Either way, legislation offers no guarantee that it was well designed or was enforced.

An analysis of state programs (U.S. General, 1989), found that delays in implementation were common; problems that caused these delays were identified but rarely resolved; evaluations of performance were piecemeal, sometimes misleading and occasionally erroneous.

If direct visible change in coastal environments is a yardstick, the U.S. program as a whole may appear not very successful. While citing problems with management of Chesapeake Bay on the east coast of the U.S., a U.S.C.E.Q. report stated that, " ... a voluntary CZMA program permits gaps in long term protection of key coastal resources. The federal consistency provisions of the act have proved ambiguous and difficult to administer ... protection of national interest resources such as Chesapeake Bay, have not been well defined."

The CZMA as a whole would appear to be neither an unqualified success nor a failure. California, through land use planning, approached coastal management from a comprehensive perspective. However, states such as Oregon and Massachusetts took a more interactive approach. A search of the literature suggests there is no truly integrated management approach to coastal zone management in the United States. The CZMA, in its attempt to be both comprehensive and flexible with regards to state obligations, fails to be either. For example, even though the Submerged Lands Act of 1953 recognised the rights of states to ownership of submerged lands, the federal government had sole jurisdiction of the water column covering that land.

Coastal management in the United States today still faces a multitude of environmental, institutional and socio-economic problems. These are outlined in Appendix I. During the Reagan administration, political support to address these coastal environment problem slipped significantly, with the result being a decrease in funds for

management programs. Subsequently, the environment has suffered, resulting in a massive public outcry over the last few years. Public pressure has made environmentalism a hot political concern, as well as an industry selling point. Some development or funding of coastal programs by industry is therefore expected, either as a legitimate concern on their part or merely to portray a good public image for their product (e.g. XYZ canned tuna is dolphin friendly !).

3.2 South West Pacific Approaches to Coastal Management

3.2.1 Regional Seas Program

An attempt at comprehensive coastal management of resources in the SWP came about in the drafting of a Regional Seas Program which incorporated most of the developing island nations of the SWP. The institutional parent of the Regional Seas Program, the United Nations Environment Program was created in late 1972 as an outcome of the Stockholm Conference on the Human Environment. UNEP's first governing council in 1973 set the health of the oceans as its foremost concern, and it remains one of seven leading issues in their programs today. The Regional Seas Program was initiated by UNEP in 1974 and at present includes 10 regions and has over 120 coastal states served by action plans they have approved in eight of the ten regions.

The South Pacific Regional Environmental Program (SPREP), the action plan for the region including the Solomon Islands, was initiated in 1980. The South Pacific Commission (SPC), the South Pacific Bureau for Economic Cooperation (SPEC), the Economic and Social Commission for Asia and the Pacific (ESCAP), and the UNEP provided the framework for the development of the action plan through a joint coordinating group.

In an unusual show of cooperation and unity at the Conference on the Human Environment in the South Pacific in 1982, all SPC member countries adopted the action

plan, signed the Declaration on Natural Resources and the Environment and approved institutional and financial arrangements for implementation of the action plan. The main objectives of the action plan were to :

(1) further assess the state of the environment in the region including impacts of human activities on lagoons, reefs and oceans;

(2) improve national legislation and regional agreements on environmental issues;

(3) develop management methods suited to the needs of the region that would enhance environmental quality;

(4) strengthen national and regional capabilities, institutional arrangements and financial support needed for effective implementation of the action plan.

A number of regional conventions and protocols have resulted from or have developed in conjunction with the SPREP action plan. These include:

- Convention of the Protection and Development of the National Resources and Environment of the South Pacific Region
- Convention on the Conservation of Nature in the South Pacific
- The South Pacific Forum Fisheries Agency Convention
- Protocol for the Prevention of Pollution of the South Pacific region by Dumping
- Protocol Concerning Cooperation in Combating Oil.

Together they broadly make provisions for preventing, reducing and controlling pollution from many sources; preventing, reducing and controlling damage from mining and coastal erosion; conserving fisheries resources; categorising and controlling the dumping of wastes and the restriction of oil discharge from tankers. Contrary to the initial accord, none have been endorsed by all SPC countries. In fact, only the Convention on Protection has been endorsed by more than three countries. The lack of regional support possibly lies in the fact that conservation of natural resources is regarded by some countries as a national matter rather than a regional one, with each country's needs

dependent on their own development priorities. A synopsis of current coastal legislation in the Solomon Islands is carried out in Chapter 5.

Although the SPREP has gotten off to a bad start, there are some benefits to a regional seas approach. The very act of instigating SPREP meant that environmental quality became a priority among all SPC countries. The voluntary nature of the regional seas program helps to foster a sense of international goodwill, mutual benefit and regional self confidence (Ocean Year Book, 1983). The program is flexible enough to allow nations and regions to concentrate on solutions that are critical, or to which there is already common agreement. The requirement that at least four nations adopt the action plan and subsequent conventions and protocols, ensures improvement and congruency between environmental laws in all the SPC countries. Another strength of the program is the multilateral and multi-disciplined scientific participation. Specific projects carried out so far under the SPREP program have been aimed at marine pollution, fisheries protection, marine research in oceanographic phenomena, tourism, mangrove and reef conservation and protection of migrating mammals and birds (SPREP, 1988). Coastal management as an integrated program to date has not been addressed.

Since projects can only be carried out after a request by a SPC country to SPREP and the subsequent evaluation, revision, costing, possible acceptance and provision of financial and technical aid, most projects cannot respond quickly to resolve conflicts. Because nearly all members of SPREP are developing countries, support measures for training, management and project implementation has had to come from outside the region, mainly from multilateral and bilateral aid sources. This has brought some undesirable consequences, as outlined in Chapter One. As the name implies, a regional seas program is primarily concerned with the water column. Very little consideration has been given to land use issues that impinge on coastal resources to date.

3.2.2 American Samoa

American Samoa is a test of the application of the United States CZMA in a different socio-cultural setting. American Samoa is an American territory with all the advantages and disadvantages of having the U.S. as a bureaucratic model. It is a complex mixture of traditional cultural practices and modern western institutions. Unlike other SWP countries, American Samoa uses primarily a cash economy, single purpose government agencies and competitive schools and business practices, modelled after their U.S. counterparts, to conduct daily territorial affairs (Templet, 1986).

The U.S. influence began in 1899, initially through the U.S. Navy and its use of Pago Pago Harbour, which is one of the best in the SWP. The harbour is the centre of commerce, industry, government, settlement (which since has increased six-fold) and tourism in the territory (Let's Go, 1989). It is also an area of particular concern for the program, due to heavy pollution discharges.

An interesting aspect of the program is the designation of the entire territory as the coastal zone. The Development Planning Office was designated as the lead agency, responsible for 'enforcement' of the program policies under a networking arrangement (i.e. agencies involved deal formally with each other as well as with the lead agency). Although Templet in his description of the program (which was primarily his creation), conveys what seems to be a smooth administrative machinery, it does seem to have its problems.

The inclusion of indigenous traditional cultural experience was made a priority in the program preparation, but seems to be largely ignored in past program activities. For example, an extension to the international airport runway into Pala Lagoon was constructed despite the objection of traditional lagoon owners and fishermen (Ward,

1989). The salt water lagoon now has severe environmental problems caused by the runway partially blocking the opening to the ocean, reducing water exchange.

The program was created and carried out by mainland Americans and although the program was initiated in 1980, an American Samoan has only recently been appointed director. The DPO, as the lead agency, was created through a Governor's Executive Order. The Order does not however give it direct authority over the differentiated departments involved in coastal activities. There is no (legislated) local government in American Samoa, but 92% of the land is governed by chiefs and village councils (NOAA, 1989). Little progress is being made by the DPO in working with villages to develop land use plans.

The American Samoa CZM Program would seem to be a carbon copy of the continental CZMA model with token reference made to Pacific Island traditional values, geography, geology and tropical environments. As has been seen in other development programs throughout the SWP, there appears to be a structural failure in the design concept of the management program. The basic framework was designed for coastal states of the U.S. Most of those programs would have had as a start more base line data; elaborate information collection, storage and retrieval systems; cooperating institutions, technical expertise and to a degree data transfer, exchange and sharing tradition. With the export of this structure to a island system with only minor modifications, the absence of these key element has become a serious limiting factor. It could also be said that the Samoan people have more at stake in the coastal zone than continental U.S. citizens, but the program execution again does not reflect this. At present, the program does not appear to be attaining its legislative goals.

3.2.3 Traditional Resource Management in the Solomon Islands

The traditional approach to resource management in the Solomon Islands can best be expressed by Dahl and Baumgart (1982):

> ... Environmental management is not a new concept for Melanesian peoples. Wherever natural resource management was needed, the traditional cultures of the region developed practices which protected their essential interests. These included land and reef tenure systems, permanent and temporary taboos on specific species or places, refined and selective fishing techniques, agro-forestry, terracing and irrigation, windbreaks, bush-fallow, and other agricultural and soil management practices etc. The cultural heritage of the Pacific is full of examples of sound environmental management equivalent or superior to modern methods. One of the greatest tragedies of the region is that this heritage is rapidly being lost just as the need for it is increasingly apparent...

The types and importance of marine conservation in the Solomon Islands far outweigh all other forms of traditional resource conservation practices, as can be expected of people who live in the coastal area. Master fisherman who acted as fisheries ecologists and conservation officers were predominant in Melanesia (Allen, 1976) and can still be found in various areas. Marine tenure systems that placed restrictions on geographic area, season, specific species and food type also helped regulate the harvesting of aquatic resources.

Fishing rights to specific areas surrounding islands or villages were often controlled by local chiefs or simply claimed as their own personal property (Crocombe, 1971). The opening and closing of fishing seasons was used as a tool in managing resource exploitation. Species regulations were also enforced, with certain species avoided at critical times (e.g. spawning) and some species were only to be eaten by chiefs or priests.

Resource restrictions were usually reinforced by a complex set of magical and religious taboos, either placed by the chiefs or by the master fisherman. Punishment for

breaking taboos ranged from fines to death. Crude forms of aquaculture were also used as a method of conserving marine resources.

Most of the mentioned techniques were employed consciously for conservation purposes. However, a number of practices were frequently bound up in religious and social rituals and customs, and not recognised for their management qualities. The wantok and big-man systems used in the Solomons should also not be underestimated. Both are essentially a concensus building network used as a village or inter-village social management tool. Their function as a communication channel could well be used as a role model among developing country government managers, senior planners and user groups in the implementation of a CZIRM program.

3.2.3.1 Degree of Effectiveness

Examination of current literature would seem to indicate that most traditional resource management was effective. By custom and necessity, Solomon Islanders applied management techniques learned through experience to sustain the resources upon which they depended. Force et al. (1975) puts traditional resource management in perspective when he states that "...not all practices worked any more than western measures work. I am confident however that some did work...." The important point though, is the very fact that there were some type of management practices in place. Even though before and during colonial times there were none of the current industrial stresses on coastal areas, coastal management was still considered necessary for sustainable resource use by the traditional inhabitants. However this is not to say that traditional islander groups always did what was best in terms of coastal management. A question also arises concerning the customary land and ocean tenure system used in the Solomons. Is it a true representation of indigenous land ownership or is it a simply a colonial interpretation? The answer has a

significant impact on the need and utility of incorporating some traditional values in CZIRM.

The traditional systems have broken down in the Solomon Islands because of a number of factors as introduced in Chapter One. There is now a resurgence in local, regional and international organisations to identify, evaluate and preserve some traditional systems that have survived the western imposition or have evolved with it. The most notable of these is research done under the SPREP. The value of traditional techniques has been recognised (Crocombe, 1971; Baines, 1984) and so there needs to be provisions made for incorporation in modern programs. American Samoa is an example of an attempt to undertake such an action, although it is a poor example.

The practices of traditional management of marine resources are not unlike techniques used today throughout the United States coastal zone. Fishing season, species regulation, fishing rights and food avoidances could be used with little modification before codification into legislation structuring a CZIRM plan (although codification of customary tenure and management techniques is in itself a contradiction of terms). The concepts of chiefs' or master fisherman's authority could be included in the designation of a lead management agency for CZIRM. The concepts of consensus building, essential to the successful implementation of CZIRM, is already deeply imbedded in wantokism and the big-man system. Caution must be used however:

(1) Not all practices were constructive.

(2) There is still an islander resentment of those who were responsible for breaking down traditional systems and who are now trying to reinforce them.

(3) It may not be plausible or even desirable for islanders to revert to former ways.

It is clear however that some consideration must be given to traditional resource management techniques in the formulation of a CZIRM program. As Johannes (Klee, 1980), a marine biologist states, "... their traditional knowledge of marine ecology clearly

surpasses that of marine biologists in some ways. I went as a consultant to a fishermens meeting ... and came away having learned more from them than they from me ...."

3.3 Choosing Appropriate Strategies

The coastal management strategies discussed above each have some positive aspect which may benefit the implementation of a CZIRM program in the Solomon Islands. The characteristics that distinguish the Solomon Islands from developed countries such as United States have been discussed in Chapter One. However, the two main characteristics which affect CZIRM need to be further investigated :

(1) level of development and coastal orientation;

(2) spatial scale of coastal issues.

3.3.1 Level of Development and Coastal Orientation

The Solomon Islands can be classed as a small developing island nation (EIU, 1987) with a strong traditional and current reliance on the coastal area for economic, social and cultural betterment. In summarising the coastal strategies used by other coastal agencies, most have some positive qualities with respect to their use in a developing country situation. To a certain extent, exclusions zones as used in Puerto Rico could have had their origin in the traditional practice of the Solomon Islanders. Exclusion zones are appropriate to a developing country because they are simple to establish and enforce. They are incremental by nature but could be a starting point for or form part of a more complete program dealing with coastal resources.

Critical area designations such as those enacted in Massachusetts already are being used on a limited basis in the SWP, though not in the developed countries of Australia and New Zealand. They are once more an incremental approach to coastal management. In order for critical areas to be delimited, there is usually a preceding requirement for extensive, solid, site-specific information. Therefore such programs require more

financial and technical input, which would be mostly subsidised by government. They are not a complete solution but could be used as part of an integrated approach.

Broad scope sectoral management requires a strong national commitment to develop each specific economic sector. Because of its attempt to be comprehensive, it is far more demanding on time, staff, expertise, administration and information than the previous two methods. It may very well incorporate aspects of these methods within each sector. Sectoral planning although focused within each sector is comprehensive in geographic coverage.

Land use planning and regional planning are the most comprehensive and demanding in requirements of information, expertise, coordination among government agencies and strong linkages between analysis, plan making and implementation. They also require the longest time before successful implementation, if implemented at all. Land use planning as a coastal option could be appropriate in the Solomon Islands if the entire land area plus coastal waters were delimited as the coastal zone. Land use planning along with regional planning on a smaller scale have the capacity to address and regulate coastal economic sectors, land ownership disputes, traditional social rights, the range of environmental/economic impacts and the high level of coastal dependency of a developing country like the Solomon Islands.

3.3.2 Spatial Scale

Coastal issues are manifested at several distinct geographic scales. The question of scale has significant relevance to the adoption of an appropriate management strategy. It affects the whole strategy in implementing CZIRM program. At a very simplistic level, the need for CZIRM increases with the geographic extent of the program. At the site level, conflicts over land tenure or use may arise which are resolved in the context of a critical or special area plan for a single site. Smaller scale issues such as public access or

beach erosion may affect a larger coastal area length wise but may be limited to a narrow width of the coastal zone. In this case a shoreline exclusions strategy may be used as an appropriate tool. Other issues could emerge, such as the pollution of Pala Lagoon in American Samoa, which needs to be addressed as a regional planning program. Finally, some issues directly affect the nation as a whole and are approached from a broad sectoral perspective. The perceived scale of issues is also a function of the dimensions of a coastal nation. For example, in the Solomons critical or special area planning may be in reality equivalent to land use planning in the U.S.A.

An appropriate approach to developing a CZIRM program would be to begin at a regional level, rather than the national basis, largely to allow a concentration of major issues in a distinct area of the coastal zone. It is logical because the shoreline of the Solomons is essentially open space; however there are areas in critical need concentrated around the port of Honiara and at Morova Lagoon. The initial benefits of approaching CZIRM in this manner would be :

(1) A regional area approach to CZIRM allows a concentration in staff, funds, expertise and technology, improving the odds of successful outcome.

(2) The successful program will serve as a model for other areas and could be expanded as the need arises and/or financial, technical and person-power resources are made available.

A regional program incorporating the goals and spatial coverage of land use control and regional seas programs would seem to be a positive step towards CZIRM in a developing SWP country like the Solomon Islands.

CHAPTER FOUR

CZIRM INFORMATION AND TECHNOLOGY REQUIREMENTS

In 1775 Samuel Johnson wrote a letter to an associate, James MacPherson. "Knowledge is of two kinds," wrote Mr. Johnson, "we know a subject ourselves or we know where we can find information upon it." (EDSC, 1982). More than two hundred years later this statement holds true. As the wealth of knowledge becomes greater, coastal managers can no longer rely on their own knowledge but must depend increasingly on finding the knowledge they need — information. With respect to developing SWP island countries, herein lies the problem. An AID report published in 1979 pointed out that the lack of adequate data is one of the principal impediments to more effective environmental and natural resource management in developing countries. Analogous to the AID report, a Commonwealth Secretariat (1982) report, along with a joint study carried out in 1986 by the Forum Fisheries Agency (FFA) and the Canadian International Centre for Ocean Development (ICOD), stressed that although information was available in and from the SWP region's major marine research and development institutions, there were serious deficiencies in the collection, organisation and dissemination of information (SPC, 1987). In order for CZIRM to succeed in the Solomon Islands, adequate information and appropriate information technology is needed.

The use and viability of remote sensing as a data gathering tool for coastal management activities has been attested to by experts such Konecny, Kensington, and Jupp in the International Symposium for Remote Sensing of the Coastal Zone (1988). The successful application of geographic information system (GIS) technology to help solve coastal problems has been documented by Howey and Blackmon (1987), Davis and Davis (1989), and Nyarady (1990). The difficulties faced by a developing country in the SWP with respect to transfer of such technology, are just as tough as the coastal

management problems with which the technology will be used to prevent. As Jolly (1977) points out:

> ... it would be unethical indeed for a profession so directly involved with reconciling human needs and the outer limits of our fragile environment to ignore the pleas of the people that technology is supposed to serve. It would further be unpractical [*sic*] in ... a resource management scheme to deliberately set aside the concerns, aspirations and potentials of the people who will ultimately become the working hands and hopefully the beneficiaries of the proposed actions.

To this end, a process for selecting appropriate technology for CZIRM in the Solomon Islands is set out in this chapter.

4.1 Nature of Information

Information plays a critical role in determining the performance of CZIRM process. As pointed out by Dorcey (1983), "Lack of knowledge ... frustrates management, making the process less productive, and worse, reduces it to 'struggling' ". It could be said that many coastal agencies have been struggling for some time. For something as vital to our society as information, it is a confusing concept. It is invariably called data or knowledge and is often claimed as the exclusive domain of those who communicate through machines.

However, information about the coastal zone can be classified in four ways: descriptive or functional and spatial or non-spatial. The important difference between descriptive and functional information is that descriptive information merely describes the elements of the coastal zone, while functional information goes beyond description of the elements to specify cause and effect relationships between them. Functional information can be defined as:

> ... the resultant of modelling, formatting, organising or converting descriptive information in a way that increases the level of knowledge for it's recipient. While descriptive information is by nature objective, functional information can be viewed as being subjective and exists only relevant to the recipient.

Descriptive information is most commonly termed as data. Functional information is the essential requirements for acquiring predictive knowledge necessary for effective CZIRM decision making.

These two types of information are clearly distinct and so are the investigatory techniques that are used in generating each type. New descriptive information can be obtained by inventorying and monitoring. Inventorying of coastal systems emphasises the description of physical, chemical, biological, economic, social and institutional elements at different locations at one point in time (Burroughs, 1986). Monitoring emphasises the description of each of these elements at different points in time (Fox, 1976). Functional information is obtained by analysing and processing descriptive information into a form meaningful to the recipient and of value for current or prospective decisions (McLaughlin, 1987). Figure 4.1 shows the relationship of descriptive and functional information to CZIRM decision making.

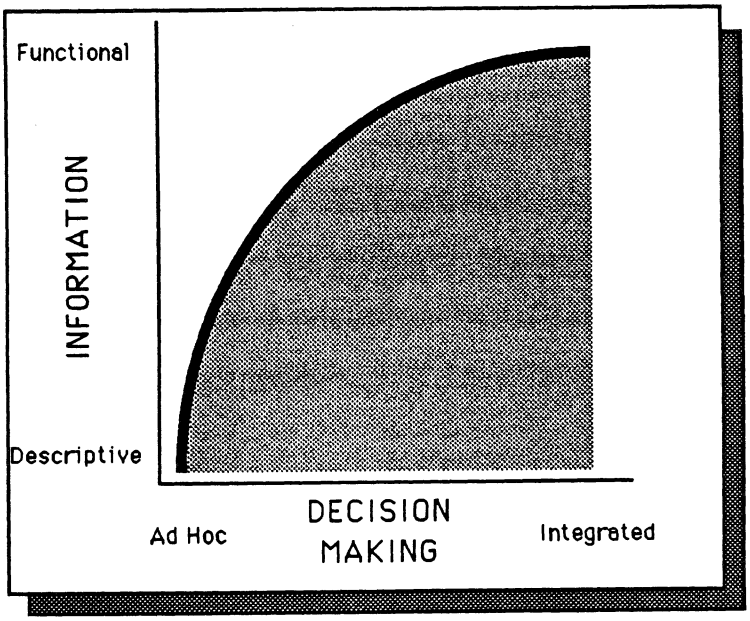


Figure 4.1 Relationship of descriptive and functional information to CZIRM decision making.

Information can also be spatial or non-spatial. For the purposes of this thesis, non-spatial information is defined as encompassing information which has no direct geometric quality (i.e. space independent). Non-spatial information is usually derived by and from the various art and science disciplines and is presented textually in the form of scientific studies or social research. The textual component describes the attributes of the coastal zone and the activities that occur within. Information which is spatial has a geometric component which can be graphically represented as points, lines or polygons. The location of these entities is usually given with reference to a coordinated system. The link between the spatial and non-spatial information and the relationship to coastal disciplines is shown in Figure 4.2.

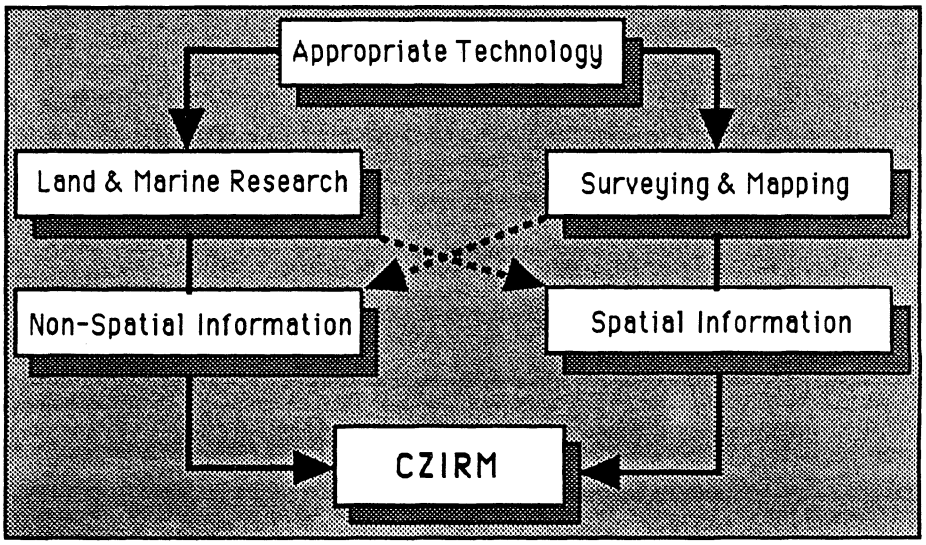


Figure 4.2 Spatial and non-spatial information.

This chapter will primarily be concerned with the transfer of appropriate information technologies needed to acquire, store, process, retrieve, analyse and package coastal zone information for CZIRM.

4.1.1. Non-Spatial Information Management Initiatives in the SWP

The inadequacy of SWP regional and national information services for marine resources was affirmed by a report by Fakahau and Shepard (1982) which identified that, "... records of past activities are generally poor... . Most of the earlier work has been inadequately reported or not reported... . Few Fisheries Divisions (have) well run libraries... and useful material is buried in files or simply lost." Using the Solomon Islands as a case study, the project located 450 previously unreferenced coastal management related documents produced by SWP agencies. The study identified that most SWP countries do not realise how much useful information exists within their own countries, mainly because it is in a form not readily available to coastal resource users.

Acknowledging the need to keep track of coastal research documentation, a draft proposal for a Pacific Island Marine Resources Information System (PIMRIS) was put forward in 1986 at the Eighteen Regional Technical Meeting on Fisheries (Watson, 1989). The proposal was sponsored by the University of the South Pacific (USP) and the South Pacific Commission (SPC). The proposed system involved the creation of a computer accessible, comprehensive, bibliographic database which would eventually contain reference to all relevant marine resource documentation produced by the various government agencies and research establishments throughout the SWP. The plan also included the provision of an ICOD scholarship for one SWP island national to complete a Masters of Library and Information Science in Canada. The national would then take over the information management functions for the project, a departure from the norm of expatriate controlled programs.

PIMRIS is possibly the first and only attempt at developing a networked information system in the SWP. Its development is based on strengthening existing infrastructure and resources within the participating countries rather than the establishment

of a new disparate system. It recognises the need for an information system to be developed, implemented and operated by the users themselves. It is currently still in a development stage, however, the ICOD based in Halifax (Canada), has provided support through the posting of a technical expert to the SPC for two years and monitory aid totalling $370,000 (Watson, 1989).

Access to and integration with a fully operational PIMRIS is seen as critical to effective CZIRM in the SWP. The current duplication of expensive data gathering projects (and the purchase of related technology) could in some cases be avoided if information is identified through a PIMRIS search. The successful implementation of PIMRIS is dependent on institutional cooperation for the sharing of information, products and services at national (departmental), regional (South Pacific Commission) and international (aid agency) levels. The formalisation of foundations and arrangements for information sharing established through PIMRIS, would facilitate implementation of CZIRM in countries such as the Solomon Islands.

4.2 CZIRM Goals for Information Technology Use

The success or failure of CZIRM in the Solomon Islands is dependent on the availability of both information and information gathering technologies. However, it is unlikely that any real benefit of state of the art information technology (I.T.) can be achieved unless it is coordinated with institutional, social, economic and organisational improvements. This has already been shown in the Solomon Islands which is littered with abandoned agricultural processing equipment acquired through aid programs that have collapsed with the departure of the supervising organisation. The simple transfer of new technology or as in this case plant machinery, would not seem to be a viable solution. Dale and McLaughlin (1988) concur by saying that :

> While sophisticated technologies are extremely useful tools, their introduction in developing countries requires high capital investment and

> costly maintenance...lack of confidence in the systems may result in reverting to well-tried and trusted manual techniques and a failure to take advantage of all that modern technology has to offer.

CZIRM seeks to compensate for the current emphasis placed upon technology only as a solution to information inadequacies through a multiple perspectives approach as outlined in Chapter Two. To this end CZIRM has a number of objectives with regard to utilisation of information technology.

(1) The successful exploitation of I.T. for CZIRM depends on the ability and willingness of a participating agency to use the appropriate technology — ability relates to education in both use and capabilities of a system and willingness relates to the ease of use. If management has difficulty using a system and with no near user support, the human response would be to stop using it.

(2) The I.T. must be used to serve CZIRM program goals, not merely to be a technical system delivering a technical service — the technology used for CZIRM must not be treated separately from organisational issues, otherwise the risk of an efficient technology not effectively serving its users increases.

(3) The implementation of I.T. must coincide with organisational and social change — with the availability of off-the-shelf GIS, remote sensing and hydrographic surveying technology which need only be 'plugged in,' its success is largely dependent on the degree to which users have been involved in the identification of need and selection of the technology. There is little benefit for an CZIRM agency in the Solomon Islands if there are great leaps forward in technical innovation when the organisation can or will only move forward gradually. SWP time in this respect is slower than most.

(4) The I.T. must compliment as much as possible the existing environment, organisationally, economically and socially — the technology itself may not always be the villain when a new technology does not provide better information for managerial decision making. For example, the cost of comprehensive data storage may be economically

prohibitive for a single agency, therefore reducing critical coastal data sets, or, human resource changes to enable 24 hour technology use may adversely affect production if it is not a general work practice.

4.3 System Design Methods

To obtain the benefits of information technology for CZIRM, there are many human and organisational issues to be confronted before the implementation of appropriate information technology. As pointed by authors such as Yourdon (1982), Zwart (1985), Ezigbalike (1987), and MacKenzie (1989), there are many variants in system design methods used to implement information technology. By reviewing these methods, an appropriate technique may be identified for CZIRM within the limitation presented by a developing island country such as the Solomon Islands.

There are a number of ways to classify system design methods. Figure 4.3 classifies these methods with emphasis on the way in which the methods relate to organisation structure and level of interaction between the technology experts and system users.

The first axes distinguishes between purely technically designed systems with little or no interaction with the end user, and systems that have been developed by the user for the user with little or no outside technical input. The second axes differentiates between the agencies' organisational structure, either centralised or decentralised. The advantage and disadvantages of centralised and decentalised information management are outlined by Ezigbalike (1987).

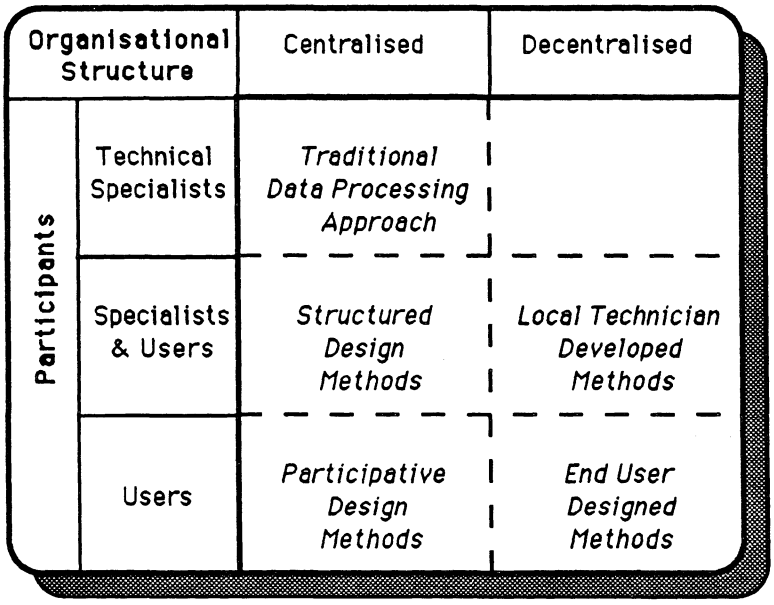


Figure 4.3 System design methods (after Wainright and Francis [1984]).

4.3.1 Traditional Data Processing Methods

Traditional data processing design methods, the most common being systems analysis and design, have been used mainly for implementation of large mainframe computer based architecture within organisations, hence the centralised classification. They have developed along with and because of advances in computing capabilities. The design process is essentially a linear progression, as shown in Figure 4.4.

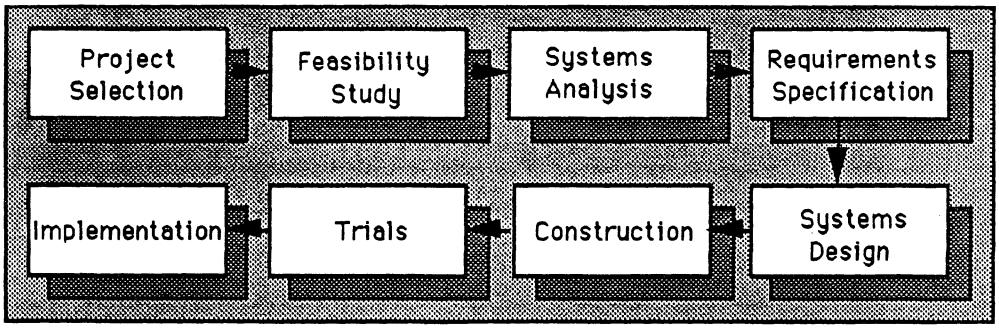


Figure 4.4 Systems analysis and design.

As pointed by Buchanan and Boddy (1983), the major problem with this type of approach is, "... that there is very little recognition that the system will be operated by a number of human beings who will themselves be operating in an organisation's environment." This is a carry-over from the need to solve the technical problems of earlier computer systems and simply get the system running. Organisational problems were not considered part of the formal design process. Therefore management only becomes aware of the implications of the new technology and the adaption that would have to be made, once the design process had passed the point of no return (Figure 4.5).

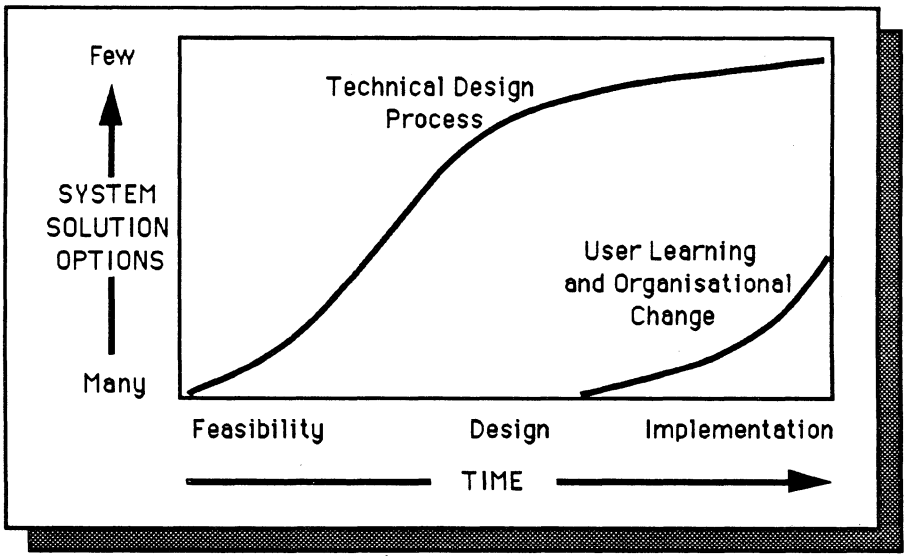


Figure 4.5 Technical design before organisational consideration (after Eason [1987]).

This method makes no attempt to incorporate the user in the design process, except after the feasibility study where reports stating cost, benefits, and requirements are reviewed. The design then proceeds according to what the user is willing to pay. After the information system requirements are specified, the design process is primarily focused to meet those specifications, allowing very few 'second thoughts' on the part of both

designer and user. This design process is also characterised by the philosophy of defining, designing and implementing the system in one series of steps — a one shot approach. After implementation it is assumed that the only problems users will face are operational and maintenance based. This contrasts with a steadily evolving and changing system that would have to deal with new applications and changing information requirements to face CZIRM problems.

4.3.2 Structured Design Methods

Structured design methods, as the name suggests, provide a more thorough approach to information system design through the provision of well documented and consistent procedures by which technical systems can be created. They depart from systems analysis methods in that the user assesses the design process at each stage (Figure 4.6).

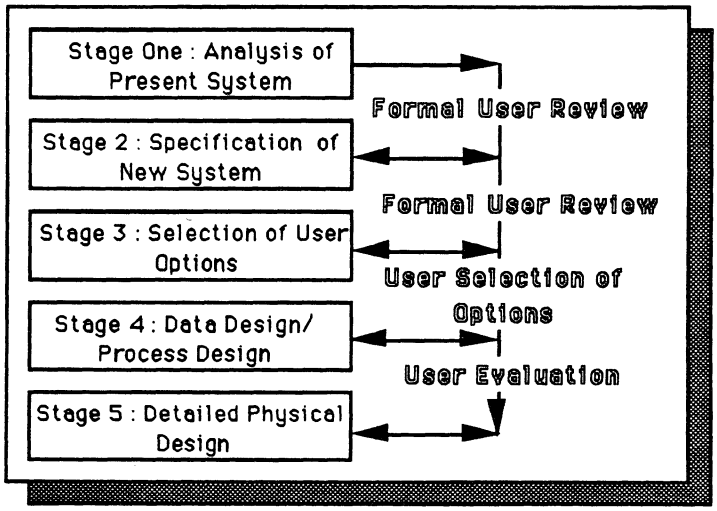


Figure 4.6 User involvement in structured design methods.

These stages are not unlike the linear sequence of traditional data processing methods. There are a number of problems with this approach however :

(1) Technical knowledge — users have trouble understanding the initial technical proposal.

(2) Communication with specialists — difficulties arise in communication between users and technical specialists.

(3) Defining needs — users find it hard to define their present needs with respect to a technology they know little about.

(4) Seeing opportunity — related to defining needs is that ideally the user in the design process is not looking at the system merely to support present agency functions but examining information technology alternatives to see the opportunities they provide (which is even more difficult).

(5) Technical only — although users are more involved than in the traditional method there is still the predominance with technical issues.

(6) One shot approach — while the users have a limited window to system design considerations, the requirement specification is still a one shot methodology with no iteration.

The primary function of the user involvement is to judge whether the specification of the technology system is appropriate and the technical solution will perform the required tasks. The fact that in most developing country situations the user is ill prepared for this role, means that their input is of limited value. Eason (1989) summarises the limitations of structured methods by pointing out that the methodologies are designed for the technical aspects of information management and give little procedural help in institutional, social and organisational change. Secondly, although the user has an opportunity to influence technical design, the methods provide little time to let the user make adequate use of this opportunity (Figure 4.7).

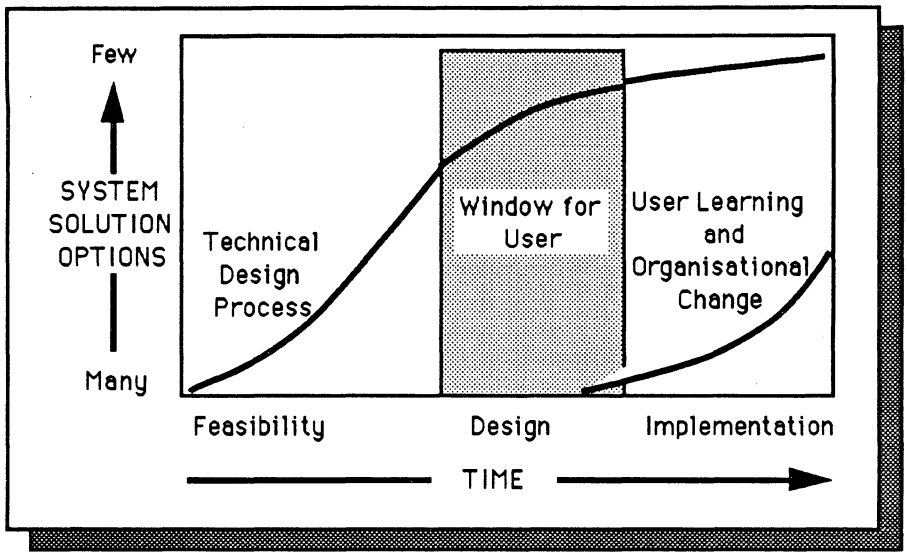


Figure 4.7 Design with limited user involvement (after Eason [1989]).

4.3.3 Participative Design Approach

Hirschheim (1985) proposed that information systems design is primarily an exercise in organisational change, which is a significant departure from the the two types of approaches discussed. Many methodologies have adapted this rationale and most of them emphasise the participation of users throughout the development process. An example of a participative design methodology is the Effective Technical and Human Implementation of Computer Systems (ETHICS) method as shown in Figure 4.8 (this is generalised diagram of a complex 25 step procedure).

This systems analysis procedure explores goals, values and sources of job satisfaction in addition to information flows, key tasks, etc., which leads to a ranking of efficiency and needs (Mumford and Henshall, 1979). The next stage is the design of a socio-technical system, by identifying the technical constraints and resources in parallel to the social constraints and resources. Objectives for each are then checked for compatibility, followed by a search for for technical and social solutions. These are again

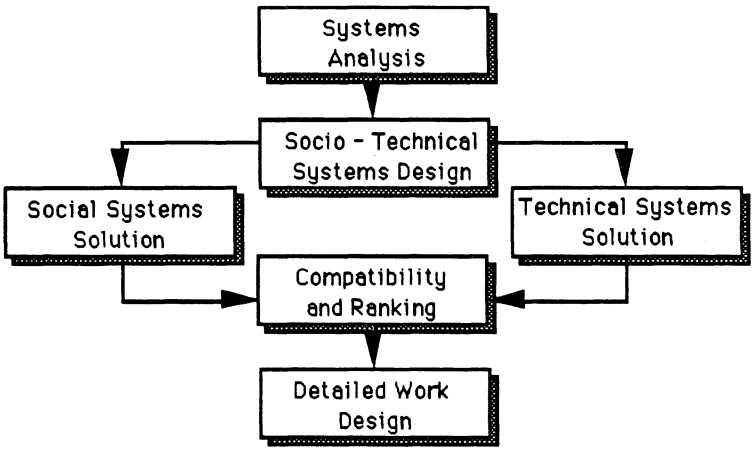


Figure 4.8 The ETHICS method (after Mumford and Henshall [1979]).

checked for compatibility and ranked according to the ability of each to meet the defined social and technical objectives. Once the outline solution has been selected, the detailed work design to implement the system begins.

This method performs the difficult task of keeping social systems design integrated with technical design through the analysis and design stage. The major problem with this type of approach is that you need an expert such as Mumford or Henshall to support the user through the maze of steps in the process. As Eason (1989) states, "... it is a complex process for people who are unfamiliar with information system design, let alone socio-technical information system design ...". Because of these difficulties, participative methods have not been widely used.

4.3.4 End User Developed Systems

With the evolution of computer technology to smaller, faster, cheaper and more powerful systems (i.e. personal computer performance now exceeds mainframes of five years ago [McLaughlin, 1987]), there has been a massive movement to small scale systems and the localised development of programs to meet user needs for information

management. This shift has been defined as end user designed methods and local technician designed methods, the difference being the lack of outside technical input in the former. Both of these methods present a number of issues for the information manager (Figure 4.9).

	End User Developed System	Local Technician Developed System
METHOD	- use of turn key packages - end user programing	- external consultant - externalprograming - information centres
ISSUES	- poor task match - reliabilty, support & expansion problems - effort required	- unrealistic demands - uneven system coordination
CONSEQUENCES	- computer anarchy - no integration on information flows	

Figure 4.9 Issues in end user developed systems.

The do it yourself approach has been made possible by the amount of software for information management and communication now available for mini and micro computers, as well as the low cost of the hardware. Where the users' needs are of a general nature, a 'commercial approach' can be an effective solution to an organisations problems. However where the users' requirements are in some way unique it is quit frequently the case that the technology is soon found wanting and the users find that it takes considerable dedication, time and effort to tailor applications to their own requirements (Yourdon, 1982).

The alternative is to purchase a system with the advice of a technical specialist and to use the specialist to develop a management approach that is specific to the users' requirements. If the system is of small scale and involves a user who is only concerned

with their own requirements or group of users with similar requirements, then the specialist has a limited specification to work to and is more likely to be successful. The possibility of outgrowing the system as applications become more complex are real however. Other factors common to these methods such as lack of data base storage for expansion, degraded performance and non-compatibility to outside information formats all add up to a poorly defined system which must be either accepted, changed or discontinued at significant cost to an agency.

4.3.5 Assessment of Methods

In looking at the five methods from the viewpoint of CZIRM, which emphasises a multiple perspectives approach involving technical, institutional, social and political considerations, these methods would seem inadequate in meeting the specialised requirement for coastal management in a developing country situation. None allow for the fact that the very act of systems design and implementation will change the users' perception of what is needed. Also very importantly for the Solomon Islands, the procedures do not contain user education and familiarisation component so that the user can become aware of alternative options.

Traditional data processing techniques are inadequate in dealing with non-technical user needs or post implementation issues, as Keus (1982) states:

> ... inaccurate, incomplete, and inconsistent specifications ... are the results of traditional strategies on system development. That is, at the beginning of a project a lot of theoretical work is performed to produce technical requirement specification documents ... [but] it is followed by a freezing of these specifications and user demands.

Structured design methods, which currently are the most commonly used method for centralised complex systems, do have a structured way for involving users in the design. Unfortunately that window is quite small and very little support is given to the user to have any effective input, severely limiting the likelihood that the resultant system will meet

the users' current or future requirements. Structured design methods are also concentrated towards the design of the technical components of a working solution.

The participative methods conversely are dedicated primarily to the organisational side of systems development, but are extremely complex to users to whom the information technologies and information systems design are unfamiliar, which is the case in the Solomon Islands. When no information management strategy has been set by an agency , a profusion of end user developed systems has been the result. This might meet the narrow needs of individual user (in some cases) but not the broader needs of a CZIRM program, which necessitates a strategically lead solution. The principle ways of developing an integrated information management system for coastal management would then seem inadequate.

4.4 A User Centred Approach to Information Technology Specification

It can be deduced from the last section that designers cannot build an information system for CZIRM until they know what is required. Users on the other hand, have difficulty stating their requirements with respect to a complex technology. For the Solomon Island, this is particularly so with respect to the technologies of geographic information systems (GIS) and remote sensing. As a result, agreeing on an appropriate specification for CZIRM using the reviewed methods would be a source of contention. The inability to produce adequate user requirements may lead to a system that fails by being neither functional, usable or acceptable.

4.4.1 Prototyping for CZIRM

A method then is needed that will allow a relatively unsophisticated user community in the Solomon Islands to :

(1) Know what is desirable.

(2) Know what is possible.

(3) Forecast future uses.

(4) Achieve concensus.

(5) Give a realistic estimate of requirements.

(6) Develop an understandable conceptual design.

(7) Identify technical, institutional, social and economic consequences.

(8) Determine how requirements are to be meet.

The proposed solution to these demands would allow the development of an appropriate design structure and set of system specifications techniques which enable the CZIRM organisation to establish its information requirements before the need to spend excessive amount of money on a binding and possibly inadequate technical solution. The use of a low cost prototyping method is therefore put forward.

The tendency to put the 'cart before the horse' needs to reversed. Rather than first purchasing an expensive technology and then determining a use, objectives of a CZIRM program need to be assessed foremost. Consideration of whether the fulfillment of the stated objectives could be facilitated by a particular technical solution would then follow. To this end, time must be allotted to allow the user to learn about the new technologies available for CZIRM, so that the possibilities of use can be related to the ultimate goals of the program. This would also serve as an introduction to the potential problems and benefits of a full scale system (both from a technical and institutional aspect). Figure 4.10 shows the application of a prototyping technique to assist in the specification of user information requirements.

Prototyping bridges the communication gap between user and systems developer by avoiding the complex flow charting of systems analysis methods which users are confronted with in determining whether a detailed conceptual solution meets their requirements. The advent of fourth generation languages have allowed designers to use application generators to rapid prototype significant aspects of a proposed system (Eason,

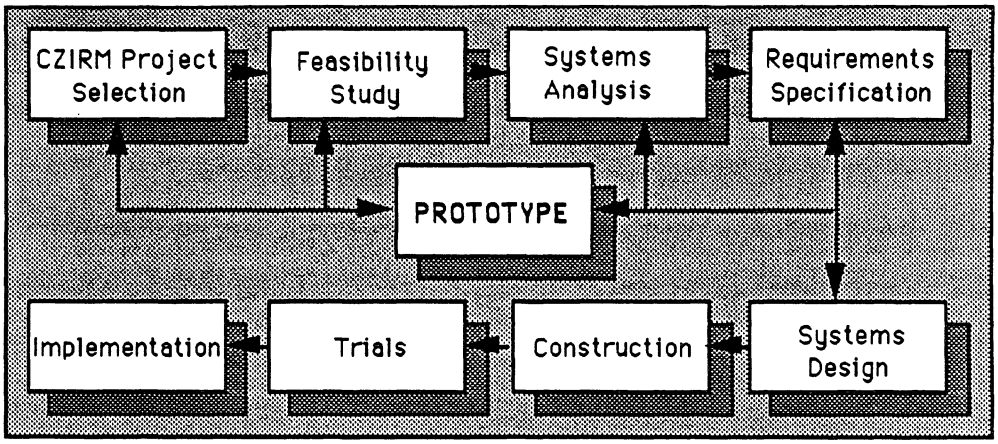


Figure 4.10 Prototyping method.

1989). Using these tools, it is possible to create screens and dialogues in a form that might be used in a real system, as well as allow a user interaction to test whether the prototype meets their requirements. This type of approach allows a more concrete version of the future system than a conceptual design on paper allows, and as Zwart (1985) suggests, it could allow :

> ... users to learn and become familiar with the operation and function of a
> ... information system prior to the finalisation of the system specification.

Prototyping of the past does have its limitation with respect to defining a workable solution for CZIRM:

(1) The prototype should not be a tool simply for technology specification, but also be a tool by which the user can formulate some of the criterion for institutional, social and organisation change (Figure 4.11).

(2) A prototype system is often seen as an early version of the final technical system, thereby restricting the flexibility for comprehensive change if users find a new solution is needed. Because it is being used as part of the whole specification process, a prototype that can be discarded before design on the final system begins is preferable.

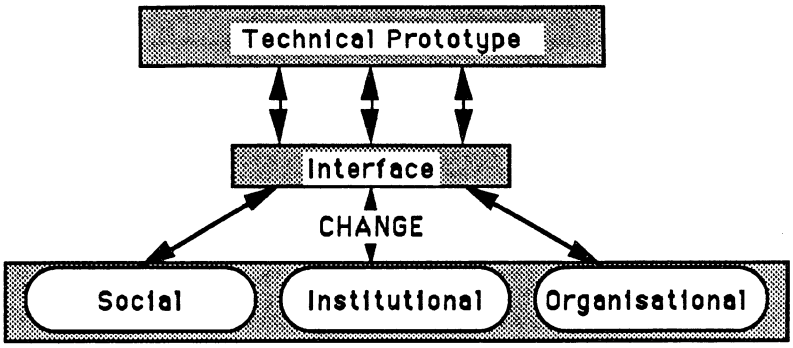


Figure 4.11 Task representation of prototype.

(3) Time and cost of building a working prototype are often cited as the major drawbacks of prototyping (Hooper and Hsia, 1982). Pseudo-prototyping has been put forward as an affordable alternative by MacKenzie (1989). Pseudo-prototyping does not have the advantage of allowing the user hands on experimentation with a system and so develop their own requirements. There is also the chance of the user perhaps being adversely influenced by the Hypercard simulated system prepared by the pseudo-prototyping analyst. The chance of being 'lead' to a technological solution supported by the analyst therefore increases.

4.4.2 MAPII™ as a Appropriate Prototyping Tool

MAPII™ is a map processing software package, an off-shoot of a geographic information system (GIS), developed by a research team from the Department of Geography at the University of Manitoba. It is a direct descendant of the Map Analysis Package (MAP) written by C. Dana Tomlin; however unlike MAP, MAPII™ runs on Apple Company Inc. Macintosh® computers. It is a spatial analysis tool that allows manipulation of information on both a visual (raster based) and quantitative levels. MAPII™ can perform creation, viewing, measuring, transforming and marking of spatial information, in addition to cartographic image processing and remote sensing image

processing capabilities. It also has the ability for crude interface with database management systems. Its qualification as an appropriate tool for the Solomon Islands will now be addressed.

4.4.2.1 Functionality

The single most important feature of a system is that it should provide a way of serving the user's needs. Knowing what those needs are with respect to GIS could be quite daunting for a user facing this technology for the first time. The technical specification must cover the functions the system will have to be able to perform in order that it can support the required range of tasks for CZIRM. MAPII™ allows the novice user community to build and experiment with applicable data sets on a real-time basis. MAPII™'s functional capabilities are shown in Figure 4.12.

One of the major problems that a CZIRM program will have is the satisfaction of a diverse user group's frequently changing needs. As Eason (1989) points out, in an unstable information atmosphere, there is a tendency by organisations to go for the system with the widest range of functionality. In theory, if a system has a multitude of applicable functions, then there is no need for the CZIRM authority to carry out a detailed user requirements study, as in all likelihood the system will be capable of doing what may be required in the future. The problem is that flexibility is gained at the expense of usability, as well as redundancy of unneeded capabilities. A study by Sutcliffe and Old (1987) showed of the 256 commands of the UNIX operating system available to computer specialists in an academic environment, 50% of the users utilised 25 commands or less. This is an example of underutilised and overly complex systems, pointing to system inefficiency and ineffectiveness in each work environment.

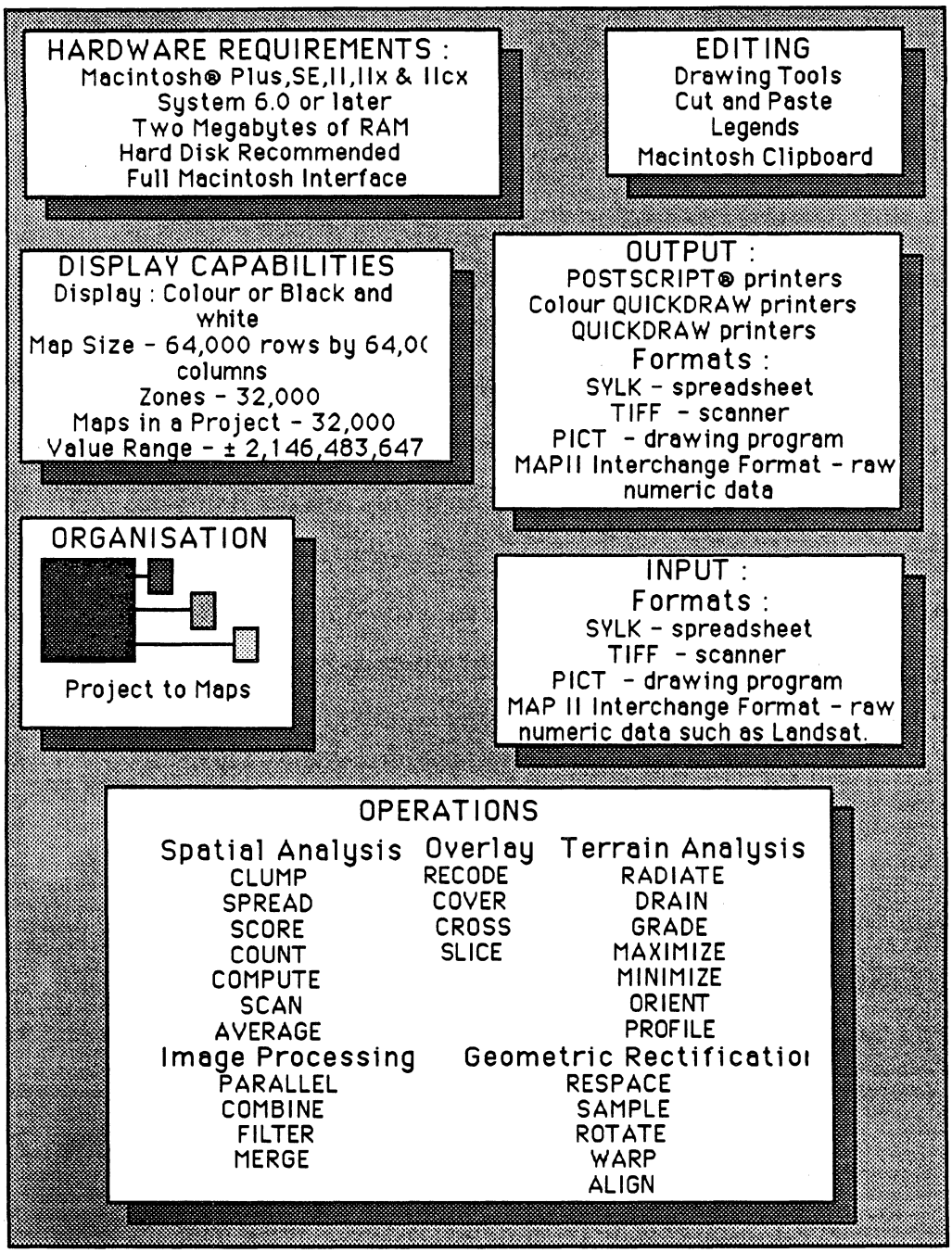


Figure 4.12 Functional capabilities of MAPII™.

The use of MAPII™ allows the user to initially match application requirements exactly with GIS capabilities. The use of MAPII™ in trials can verify that those requirements are true. Redundant functions can then be identified. This could represent substantial savings in the purchase of software and hardware for a full scale system. Through system use, identification of requirements in terms of data, further functionality, end products and ultimate system deliverables can be identified. A graphical database has been created representative of coastal management needs for a coastal community in the Solomon Islands (Appendix II). Applications showing some of functionality of MAPII™ are presented.

4.4.2.2 Usability

Once a system has the functionality the users require the next step is to ensure that it is delivered in a way the users feel able to operate. The importance of 'user friendliness' cannot be over-emphasised. The user community in the Solomon Islands will embrace a broad spectrum of society, from villagers to information specialists (Figure 4.13).

Application Expertise / Operation Expertise	LOW	HIGH
LOW	The General Public	Coastal Discipline Professional Users
HIGH	Computer Specialists	Application Specialist

Figure 4.13 Spectrum of users.

A system that a computer specialist may find usable, may be incomprehensible to a resource manager. MAPII™ has a full Macintosh® interface for its operation, with a logical screen setout of pull down menus. The Macintosh® operating system has been shown to be considerably easier and therefore faster to learn for all levels of users than IBM compatible operating systems (MacUser, 1987). Time can therefore be spent on more important aspect of the prototype, rather than on mastering an operating system that may be discarded at prototype completion.

In MAPII™, no complex commands are required to be remembered, as it has a command builder which gives the user syntax and modifiers. Examples of the screen layout are shown in Appendix III. The author has used two large scale GIS (CARIS from Universal Systems Ltd.; ARC/INFO from Environmental Systems Research Institute) running on various operating systems (UNIX and VMS) and neither system has matched the user friendliness of MAPII™. Both systems however have recognised the value of Macintosh type interface and are working towards implementing menu systems for operational control (Nyarady, 1990). The ease of use and functionality of MAPII™ would represent an ideal model for full scale systems to aspire to.

4.4.2.3 Benefits of Using MAPII™ as a Prototyping Tool

A initial advantage in using MAPII™ as a tool for prototyping is that for less than U.S.$3000, the system is ready for use (Figure 4.14). This is considerably less than the normal hardware and software costs of usual prototyping systems.

Information can be entered into the system through keyboard, scanning, drawing programs such as CLARIS™ MacDraw® II, digitising with products such as KURTA® IS/ADB™ tablet, raw numeric data files such as LandSat or through the drawing tools of MAPII™. The important point is the prototype should not be an exercise in digitising. MAPII™ allows fast, efficient data entry of existing information whether in digital or

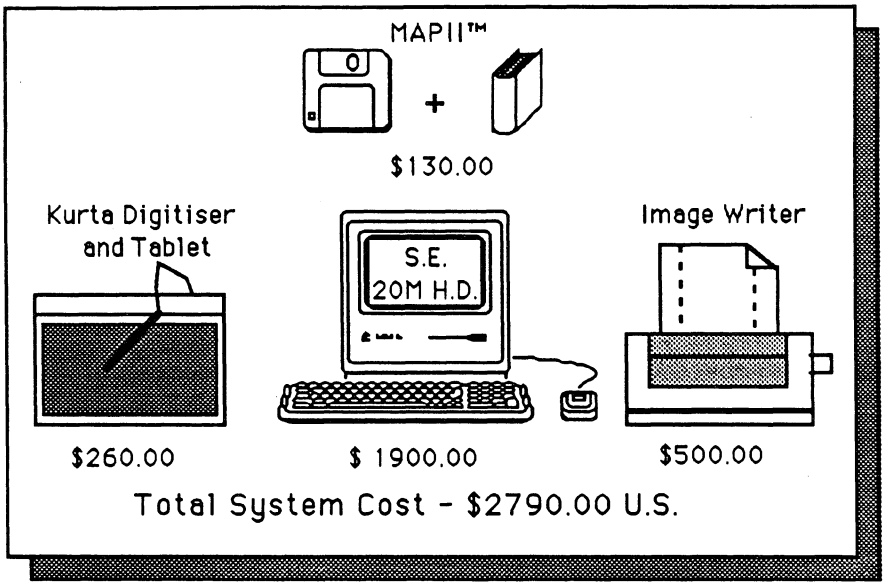


Figure 4.13 Prototype configuration and cost.

analogue form, therefore negating the need for costly data collection at this early stage of the project.

As the author has accomplished with the maps in Appendix II, if relevant data sets do not exist, it is possible using MAPII™ to 'make up' realistic information. Although information derived this way cannot be tested for reliability, accuracy or precision, it can be certified for its appropriateness for use. Due to the Macintosh® limit of processing power, data sets have to be kept small and applicable. This instills good database management habits for a later full scale system.

MAPII™ requires no specialised programing background or familiarity with operating system other than the Macintosh® family of computers. This in itself may be a disadvantage if the 'spoiled Mac users' have to change to another, less coherent operating system.

Although the use of MAPII™ may be incapable of solving many of the problems that a CZIRM may face, it still has the capability to allow the user to become deeply enough involved in a working system to flag requirements in terms of information attributes, data processing requirements, system requirements, organisational factors, cost/effectiveness and feasibility for later consideration in the system specification process. At prototype completion it is felt that MAPII™ would be an ideal educational tool for both professional and university groups, although the system could then be used for other purposes.

CHAPTER FIVE

INSTITUTIONAL ARRANGEMENTS FOR CZIRM

Institutional arrangements are defined as the composite of laws, customs and organisations established by society to allocate scarce resources and regulate competing values for a social purpose, such as to govern a nation or to manage a nation's coastal resources and environments. Dale and McLaughlin (1988) conclude that:

> Institutional issues, more than any others, determine the effectiveness and the pace of development. They directly affect the design and implementation of any system and are themselves affected by its development.

Every nation has to some degree, established its own institutional arrangements for managing coastal resources and environments. An investigation of the institutional issues affecting CZIRM in the Solomon Islands follows.

5.1 Institutional Differentiation

The source of complexity in the administration of institutional arrangements lies in the sectoral, functional and hierarchical differentiation that accompanies development. It can be expected that as the Solomon Islands attempts to become more self reliant through expansion of economically viable industries such as fisheries, logging and agriculture, there will be a corresponding increase in institutional arrangements to govern the development.

5.1.1 Sectoral and Functional Differentiation

One of the inherent problems that CZIRM has to solve and indeed is the primary reason for CZIRM, is the large number of sectoral divisions and corresponding number of government bureaucracies that directly or indirectly affect coastal resource use (Table 2.2). Sectoral differentiation, as pointed out in Chapter Two, results from government

specialisation in discrete policy areas. By comparison, land management involves relatively fewer sectors. The greater the number of sectoral departments with authority in a given management area, the greater the potential for fragmentation of government responsibility and duplication of effort. The institutional problems associated with management of coastal resources are explained in Appendix I.

Within each sector there may also be a diverse functional differentiation, with each sectoral department divided into separate divisions having different responsibilities. These responsibilities could include information management, accounting, taxing, property management, surveillance or regulation. Functional differentiation also increases the risk for duplication of effort as well as the fragmentation of responsibility.

A clear example of governmental fragmentation of responsibility was witnessed in the United States with the Exxon Valdez oil spill in Alaska. In this case a number of government departments and private agencies were disastrously slow in instigating emergency cleanup procedures due to indecision over which agency had jurisdiction. When action was finally taken, the cleanup strategy was severely hampered by the lack of geographic information of areas over which they supposedly were responsible. Through CZIRM, the Solomon Islands will be able to identify information inadequacies before a crisis forces the issue.

In a worst case scenario, where a nation has all 25 sectors as shown in Table 2.2 and each sector again has at least five functional divisions, there would be 125 points of potential government involvement in a CZIRM program. Fortunately this is not the case in the Solomon Islands where the majority of coastal management jurisdiction falls under the Ministry's [sic] of Lands and Agriculture, Natural Resource and Transportation (World Bank, 1980). There is significant functional differentiation within each department however, and it can be expected that they have varying spatial information requirements. Importantly, there is only one governmental surveying office, the Division

of Survey in the Ministry of Lands and Agriculture (Mayr, 1988). Although the country has a well established Universal Transverse Mercator (UTM) geodetic datum to which all cadastral, topographic and engineering plans are connected, Mayr (1988) points out that organisations other than the Division of Survey have a tendency to create maps or reference geographic information to datums other than UTM. The inference here is that there is a lack of information exchange between departments and a duplication of effort. CZIRM attempts to negate the problems presented by sectoral and functional differentiation by establishing horizontal integration of coastal sectors as a strategic goal. In this situation, the Division of Survey and Lands would be responsible for all spatial data gathering activities.

5.1.2 Hierarchical Differentiation

Hierarchical differentiation occurs when there are varying levels of government involvement, such as national, provincial and local. The Solomon Islands is characterised by a strong national government, with eight weaker provincial administrations which were formally called local councils (World Bank, 1980). Although the national government has had a policy of decentralisation of operations and powers since independence in 1978 (E.I.U., 1988), a number of problems can be deduced in the operation of a CZIRM program at provincial level; administrative and technical capacity would have to be strengthened significantly by an already lacking national level, the emergence of differing provincial priorities could cause an uneven management program and finally the cost of operation would be too much for provincial governments whose only sources of revenue at present are government grants.

5.1.3 Geographic Differentiation

The coastal zone is typically characterised by many coastal authorities operating under separate statutes within the same geographic location. The shoreline is often the

jurisdiction boundary for national and provincial laws and accordingly, government agency responsibility for the same sectoral function may change at this boundary. Bridgwater (1985) states that the legislative administration of the coastal environment in New Zealand is complicated by 40 or so Acts. Figure 5.1 shows the geographic delimitation of these Acts.

Regulation of freshwater and coastal pollution (under the Water and Soil Conservation Act in 1967) is the responsibility of the Ministry of Works and Development. However, the geographic extent of this function stops at the oceanward limit of the territorial waters (three nautical miles). Coastal pollution oceanward from this boundary to the outer limit of the fishing zone (five nautical miles) is the responsibility of the Ministry of Transportation. A similar legislative maze is assumed to be the case in the Solomon Islands, as the legal systems of both New Zealand and the Solomon Islands have originated from British colonial rule. It can also be assumed that where there is institutional overlap, there is also overlap in information gathering and management. Institutional arrangements are further complicated by lateral differentiation of responsibility in the coastal zone, as well as across.

5.1.4 Institutional Analysis

For a CZIRM program to succeed in the Solomon Islands, there is an explicit requirement for the definition of current institutional arrangements before final system implementation is contemplated. Although it would be possible to identify and describe all the sectoral and functional intersections for areas of government affecting the the use of coastal resources and the quality of coastal environments, it would be a time consuming and economically taxing exercise as well as an inefficient use of resources.

As stated in Chapter Two, CZIRM proposes the use of scoping techniques to overcome this problem. The target should be narrowed initially to those coastal issues or

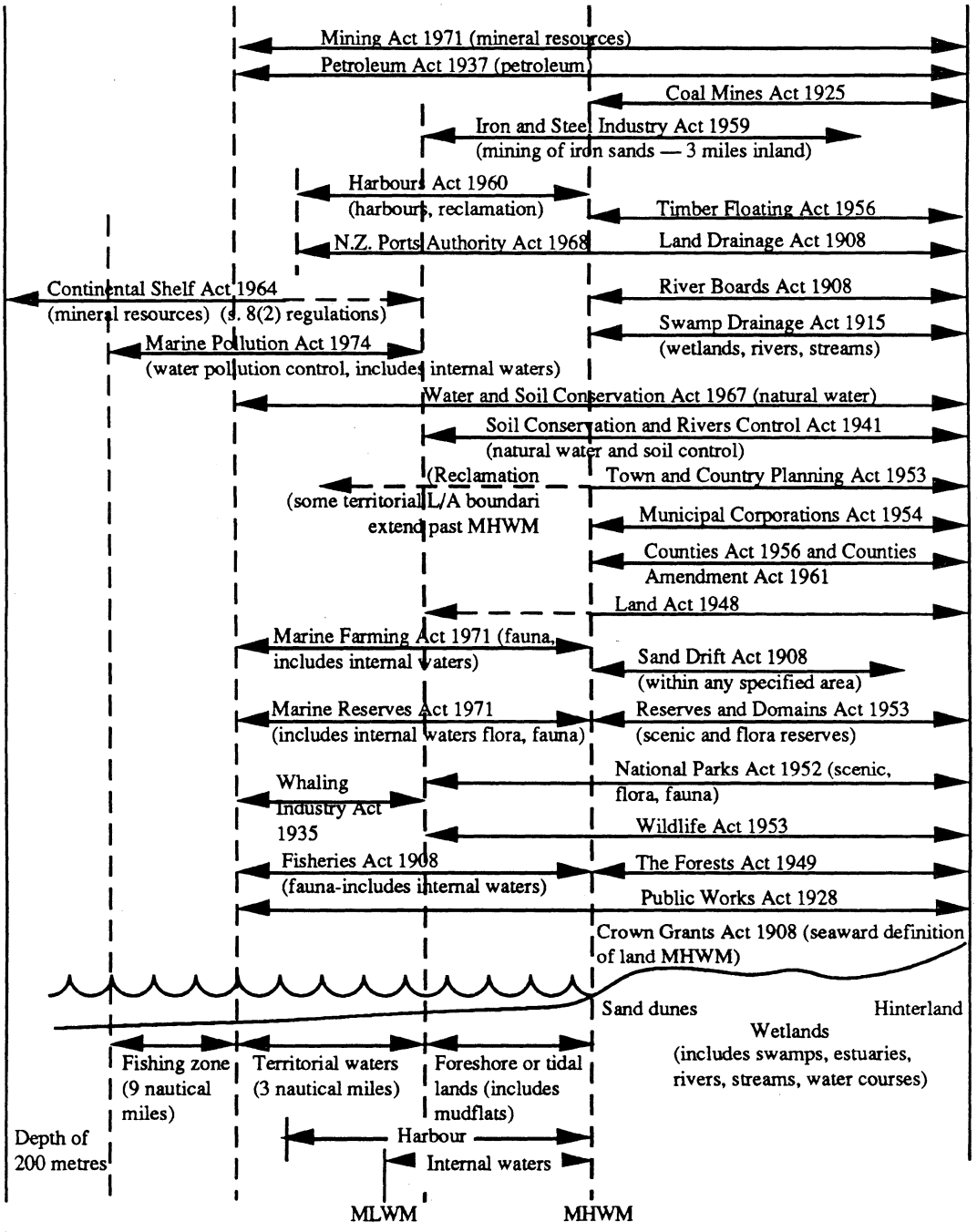


Figure 5.1 Legislative administration of the coastal environment in New Zealand (UNOETB, 1982).

coastal areas that have motivated a coastal nation to consider initiating a program in the first place. For each issue or area, the following inputs and intervening factors could then be identified (Schmitt and Smolin, 1983; Grosenbaugh, 1985).

Inputs :

(1) laws and policies that affect the issues;

(2) traditional customs that affect the issues;

(3) government and traditional units that have mandates to regulate these laws and customs and their respective responsibilities.

Intervening Factors :

(1) gaps in responsibility;

(2) fragmentation of responsibility;

(3) overlap and duplication of information used in carrying out responsibilities;

(4) conflicts in and between governmental units and customary concerns.

Grosenbaugh (1985) in her analysis of SWP legislation concerning ecosystem management identified that the Solomon Islands has no comprehensive environmental legislation or even a stated policy. There is however no shortage of legislative attempts as shown in Table 5.1, but as Grosenbaugh states :

> ... the lack of legislation is not the problem, but the coordination of authorities administering these laws ... resource conservation and environmental management are considered luxuries to developing island communities in times of economic stress and (therefore) must be integrated with economic and cultural realities such as tourist dollars, outside funding and traditional practices.

Under the National Parks Act 1954, the Solomon Islands government has established three parks. Dahl (1980) in his evaluation of the state of the environment in the SWP concluded that major parts of these national parks were of low conservation value due to forest clearing for subsistence agriculture. Poorly designed and haphazardly

enforced laws, as well as park boundaries conflicting with traditional areas have led to ineffective conservation practices.

Table 5.1 Solomon Islands coastal legislation (after Venkatesh and Va'ai, 1983).

Sector	*Legislation*
Water Quality	Public Health Act 1970- prohibits pollution of watercources, and foreshores by raw sewerage and other noxious matter.
Land Use Planning	Town and Country Planning Act 1979 - regulates development of non-customary lands to promote welfare of inhabitants.
Mining	Mining Act 1969 - provides power to subject prospecting to terms Minister sees fit.
Industry	No legislation
Agriculture	Forest and Timber Act 1969 - enables area to be declared controlled forest areas.
Culture	Protection of Wrecks and War Relics Act 1980 - power to declare restricted areas
Conservation	National Parks Act 1954 - declare area as national parks Wild Birds Protection Act 1914 - allows declaration of santuaries. - specifies offences. Forest and Timber Act 1969 - declaration of freehold and leasehold land as State or controlled forests. Town and Country Planning Act 1979 - power to preserve woodlands in the interests of amenity.
Air Quality	No legislation
Marine Environment	Delimitation of Marine Waters Act 1978 - powers to prescribe protection and preservation areas in the Exclusive Economic Zone.
Environmental Impact Assessment	No legislation.
Mangrove Environment	No legislation.
Reef Environment	Delimitation of Marine Waters Act 1978 - powers to prescribe protection and preservation areas in the Exclusive Economic Zone.

5.2 Administrative Arrangements

If the Solomon Islands decides to initiate a CZIRM program, an administrative arrangement must be selected. Review of literature reveals at least five options that could be used in the Solomon Islands (Heikoff, 1977; McLaughlin, 1987; Dale and McLaughlin, 1988):

(1) to create an interagency network coordinated through an inter-agency council or board;

(2) concentration of authority within a single existing unit of government;

(3) centralisation of authority within a single new unit of government;

(4) concentration of authority in a new or existing unit of government and the creation of an inter-agency council or board to advise the unit of government.

The key characteristics of each are shown in Figure 5.2. Although each has its strengths and weaknesses, in deciding which administrative arrangement would be preferable for a SWP developing island country, there are two main factors that need to be considered under CZIRM. These have been identified as the political and economic perspectives. With respect to coastal management programs in the Unites States, Born and Miller (1987) suggest that :

> ... the degree of program success appears to reflect the support, recognition and commitment of the governor and/or legislative leadership.

There are some questions that need to be answered with respect to threatening the status quo with these administrative alternatives.

(1) How politically feasible is each alternative?

(2) What is the likelihood of executive adoption?

(3) To what degree will each alternative promote integration?

(4) How economically viable is each alternative?

As a general characteristic, governments tend to make only marginal changes when the opportunity for institutional restructuring arises. This is usually of a cosmetic nature, with departmental name changes the most frequent. The recent name change of the former Land Registration and Information Service (LRIS) in Atlantic Canada is a case in point.

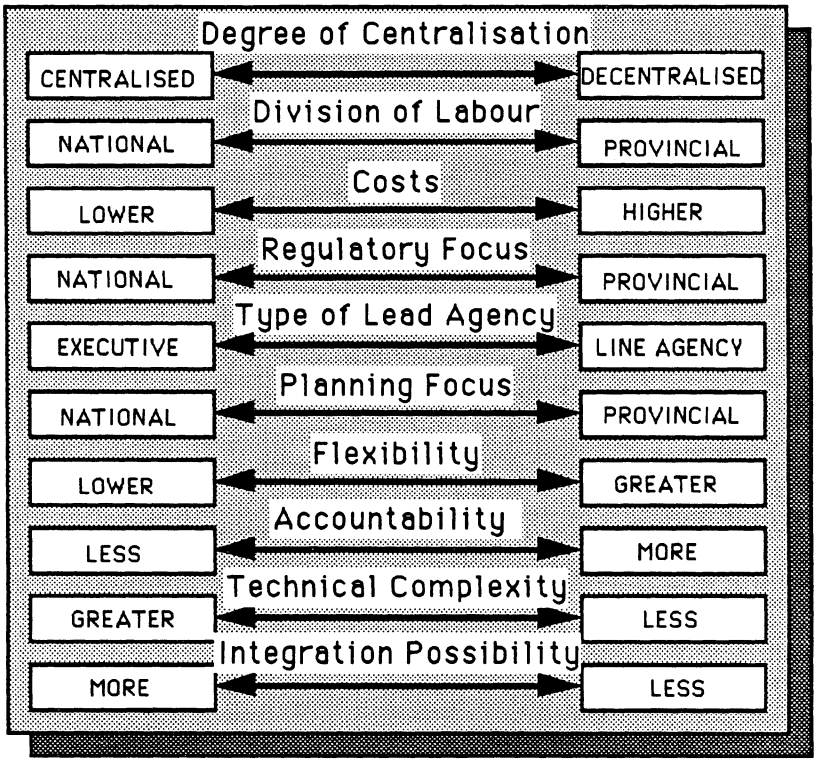


Figure 5.2 Characteristics of administrative arrangements.

It also should be noted that a CZIRM program's administrative arrangements should not be consider permanent, as they will change over time as the program moves from preparation stage to implementation. Johannes (1982) reiterates this point in maintaining with respect to SWP developing countries :

> ... any legal authorities must be flexible and responsive to change, such that customs are not "locked in", preventing the natural evolution of the system.

It is recommended that the first alternative would be the most appropriate for CZIRM in the Solomon Islands. This is analogous to the distributed information management approach as recommended by Ezigbalike (1988). Although it is the most difficult in terms of information sharing and departmental cooperation, the autonomy of each department is kept. The Solomon Islands people, through their customary social systems of wantok and big-man, have a long history of concensus building in decision making. The success of a CZIRM approach is based on mediating territorial difficulties. It is considered that integration and interaction among government, customary and private groups on coastal management issues and information exchange is plausible.

5.3 Role of External to Government Organisations (EGOs)

EGOs can be a complement to government agencies or interagency councils in carrying out a CZIRM program. In the SWP EGOs have played a major role the development of government programs and the fulfillment of social improvement. Through search of current literature for organisations that have had some type of involvement in coastal related projects in the SWP, a detailed list was derived. EGOs can be broken into four major categories as shown in Table 5.2. These organisations have performed the functions of :

(1) communication of government policy to resource users;

(2) serving as forums for critical review of government proposals;

(3) training and education;

(4) research;

(5) collection and organisation of information;

(6) providing expert consultant on development programs;

(7) financing of developing projects;

(8) supporting technology transfer.

Table 5.2 External to government organisations in the SWP.

Intergovernmental Organisations	International Organisations
Europen Economic Community	U.N. Office of the Special Representative for Law of The Sea
Council of Europe	U.N. Centre on Transnational Corporations
European Space Agency	U.N. Food and Agriculture Organisation
Organisation for Economic Cooperation and Development (OECD)	U.N. Evironment Program
International Council for Exploration of the Sea	UNESCO - Division of Marine Sciences
Commonwealth Secretariat	Intergovernmental Oceanographic Commission
South Pacific Forum	International Maritime Organisation
South Pacific Commission	International Hydrographic Organisation
Association of Southeast Asian Nations (ASEAN)	U.N. Conference on Trade & Development
Inter-American Development Bank	International Bank for Reconstruction and Development (World Bank)
Asian Development Bank	

National Development Organisations	Non- Government Organisations
CANADA	International Centre for Living Aquatic Resource Management (ICLARM)
International Development Research Centre	Southeast Asian Fisheries Development Centre
Canadian International Development Agency	International Centre for Marine Resource Development at University of Rhode Island
International Centre for Ocean Development	Island Resource Foundation
UNITED STATES	Dalhousie Ocean Studies Program, Dalhousie University
Agency for International Development	Woods Hole Oceanographic Institution
National Oceanic and Atmospheric Administration	International Council of Scientific Unions
FRANCE	International Geophysical Union
IFREMER Program	International Union for the Conservation of Nature and Natural Resources (IUCN)
AUSTRALIA	International Law Association
Australian International Development Assistance Bureau	International Chamber of Commerce
JAPAN	International Association of Marine Science Libraries and Information Centres
Japan Internation Cooperation Agency (JICA)	International Petroleum Industry Environment and Conservation Association
	U.S Joint Oceangraphic Institutions, Inc.
	U.S. National Academy of Sciences

What was the most surprising aspect was the shear number of EGOs operating in the SWP. As has already been pointed out, the involvement of EGOs in the SWP has in cases been detrimental socially, environmentally and economically due past lack of consideration for local conditions and the vulnerability of island communities. However the continued involvement of EGOs in the SWP is essential to the successful

implementation of a CZIRM program on the Solomon Islands. However, the terms on which aid is sought and given need to be modified. CZIRM supports a multidisciplined approach to program development, therefore it is vital that relevant EGOs give technical, institutional and economic input and support when and if they are requested. EGOs have the ability to plant the seed for CZIRM, but the ultimate decision to carry out a program has to be initiated and supported by legislative authorities for integration to occur.

What is needed to avoid a rhetoric cloud descending from the EGOs on a CZIRM program is a clear policy statement by the responsible governmental agency. As evidenced by legislation which places decision making "as the Minister sees fit", the differentiation of institution arrangements and the multitude of external to government organisations involved in past development programs, there has been a tendency to avoid making clear statements of priorities concerning coastal matters.

5.4 Boundary Considerations

In 1978, the Solomon Islands established a 200 mile Exclusive Economic Zone (EEZ) which laid claim to some 1.3 million km^2 of ocean and resources (Gibson, 1985). Although it would be legally possible to use the delimitation methods for determining EEZ baselines and boundaries as prescribed by the Third United Nations Conference on the Law of the Sea 1982 (UNCLOS), as a method of determining the outer limit of the coastal zone, it would be unrealistic in terms of the technical and economic capacity necessary for a developing SWP island country to administer such a expansive area. Inherent in managing the use of coastal resources is the need to demarcate realistic boundaries as limits of ownership and/or regulatory jurisdiction. The importance of placing boundaries on a coastal zone program is in evidence in the United States CZMA (1972) which requires coastal states to define their coastal boundaries before funding approval. The CZMA (1972) requires that boundaries must be broad enough to include land areas which

are influenced by coastal waters and which themselves influence or support uses which directly and significantly affect coastal waters. Under this general requirement, four criteria have generally been used for defining the coastal zone:

(1) physical criteria;

(2) administrative boundaries;

(3) arbitrary distances;

(4) selected environmental units.

5.4.1 Physical Criteria

Physical criteria for determining management boundaries include on the landward side a coastal mountain, range, watershed or major coastal road. The use of a watershed is sound and practical, since it is a boundary that can be readily determined and understood. It can encompass large areas of land in the case of estuaries and river basins. On the seaward side, a typical physical boundary is the edge of the continental shelf. This presents a problem in the fact that there is no globally recognised measurement of the continental shelf (Brown, 1984) and therefore would have to be determined by survey. A definition of the coastal zone using physical criteria has the advantage of being simple to describe and easy to understand. Such a definition may or may not respect existing political boundaries, therefore it may require special legislation to be enacted.

5.4.1.1 Customary Boundaries

Marine tenure is of particular interest and significance in determining boundaries for CZIRM. Coastal areas historically have been vital to the subsistence economy. In the traditional marine tenure system, territory exists in that a group may claim use of an area of sea, beach or lagoon. Outsiders were restricted with respect to rights to fish or use the beach areas. Additional rights also included access and passage through reefs or landing rights (Petit- Skinner, 1983).

The boundaries and extent of traditional marine territories were in many cases an extension of those on land. Most island communities do not distinguish between 'land' and 'sea,' as such. The question of how far the rights extend out to sea were determined in situations as described by Mokoroa (1984):

> ... boundaries were determined by the boundary lines on the dry land (which ran from inland to the coast and continued across the lagoon to the reef) and the sea-passages on the reef. For some places special rocks on the cliff edges were used to mark the inner border-lines. Beyond the reef, just a few feet from where the waves break on the reef is the end of the boundary line. This is marked by the site where men fished for mackerel (koperu). The boundary is known as taunga koperu ...

In most cases special markers were used to show the boundaries on reefs or beaches. Alternatively, boundaries simply, "... extend as far as one can fish or dive for shells." (Taurakato, 1984). Marine territorial boundaries also made use of the variety of natural features, in which boundaries :

> ... tend to be straight lines joining distinctive geomorphological features observable from the surface. Thus a boundary may begin from the tip of a rocky promontory, bear along a straight line to a patch of reef to continue to a patch of reef perhaps one kilometer offshore, change direction at this reef to continue several hundred metres to a pass in the main reef, then follow the seaward edge of the main reef to a conspicuous reef hole before recrossing reef and lagoon to intersect the coast (Baines, 1980).

The conflict between customary boundaries and the colonial laws establishing all land and sea below mean high water mark as belonging to the crown, has been passed on to the current independent government. In practice this has been solved by granting traditional fishing rights but not rights of ownership to these areas. The recognition of customary boundaries is essential within a coastal zone. Johannes (1985) states that :

> ... efforts to protect coastal areas by means of various sorts of protected areas are not likely to succeed if they are carried out in the absence of an understanding of such customs and a willingness to consider them as an integral part of any new management system ...

By incorporating these boundaries within a CZIRM program, although the western concept of coastal management may be foreign to traditional groups, they would tend to support methods that reinforce their traditional ways and limit outside exploitation of their resources. Security is strengthened for the traditional groups and the current customary conservation practices could help strengthen any enacted program.

5.4.2 Administrative Boundaries

Boundaries may be defined using the existing political and legal subdivisions. The use of existing boundaries has the advantage of being easily understood, immediately representable and legislatively viable. The potential drawback is that they may not include all areas of resource use or cut across sensitive biological areas. This would be a viable method in conjunction with other criteria. On the ocean side, a delimiters such as the outer limit of the territorial sea is viable solution.

5.4.3 Arbitrary Distances

The California Coastal Zone Management Program, one of the most comprehensive in the United States, has established that the basic regulatory zone is defined as extending 1000 yards inland and 3 miles offshore, with some additional exceptions (Hildreth and Johnson, 1983). This definition has the simplicity and ease of application. The disadvantage of using arbitrary distances for defining management boundaries is that quite often that area bears no relationship to coastal topography and patterns of economic activity.

5.4.4 Selected Environmental Units

The management area can also be defined as consisting of selected environmental units. For example, the State of Texas defines its management boundaries in term of composite resource areas :

> ... nearshore Gulf (waters), inlets, and tidal deltas, river - influenced bays, medium salinity bays, restricted bays, hypersaline bays and lagoons, oyster reef areas, grassflats, channel areas, submergent spoil, coastal lakes, and tidally influenced streams. The shorelands include beach and shoreface areas, wind tidal flats, tidal marches, emergent spoil, active dune areas and active or potentially active washover channels (OETB, 1982).

Using this type of method is based on sound ecological and scientific criteria. The environmental units however can only be charted after extensive local survey. The potential for legal battles over what constitutes a 'tidally influenced stream' are quite high.

5.4.5 Assessment

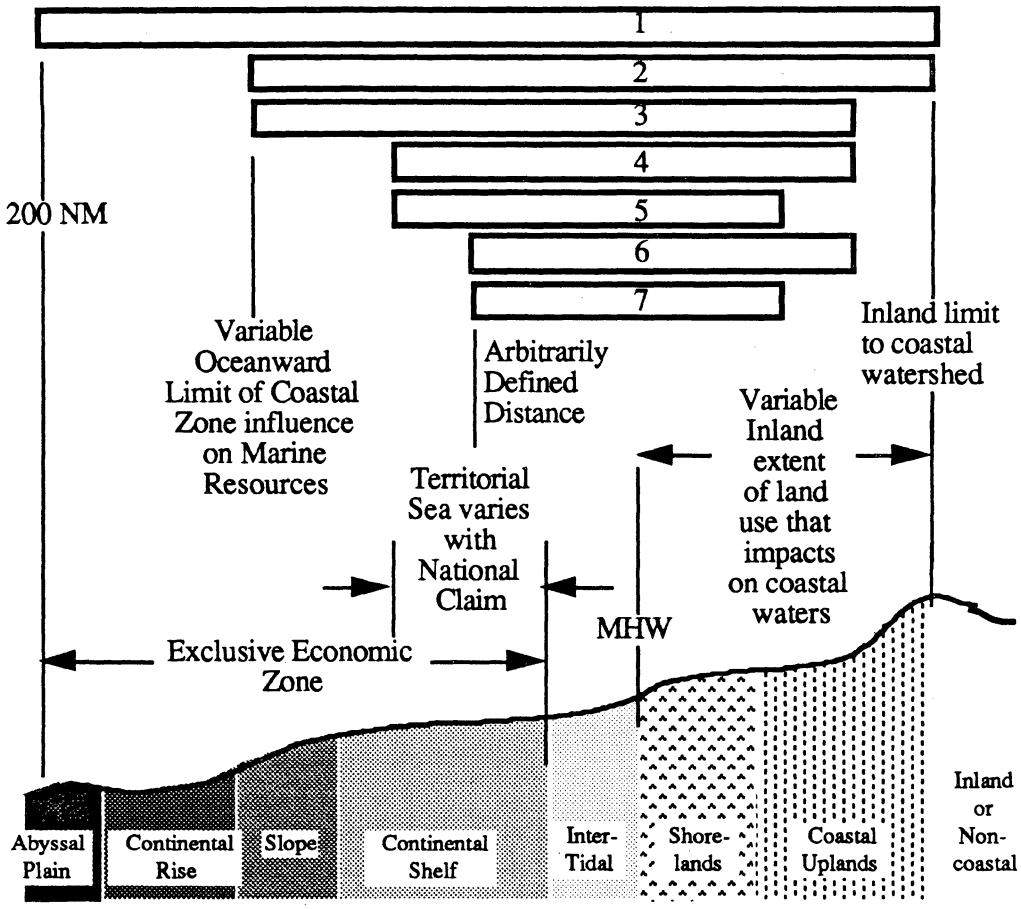
It is clear that no single criterion is applicable on its own to meet all requirements for boundary definition of CZIRM area. A combination of all criteria would be needed in a fully integrated system. Figure 5.3 shows all consideration which need to be taken into account when a boundary definition is made for the Solomon Islands. The management area , however defined should :

(1) be clearly defined in a comprehensible manner and capable of cartographic representation;

(2) recognise as far as possible existing social, cultural and political subdivisions;

(3) contain resource areas of economic and environmental significance.

In the case of the Solomon Island, the area of significant interaction between land and sea may encompass the whole archipelagoes. In this case an inland boundary may not be established and management could be considered within the national development plan.



Coastal Zone	Inland Limit	Ocean Boundary
1	Coastal Watershed	EEZ Boundary
2	Coastal Watershed	Limit of Influence of coastal waters on marine resources
3	Land use indirect impact	
4	Land use indirect impact	Territorial Sea B'dry
5	Inland extent shorelands	Territorial Sea B'dry
6	Land use direct impact	Arbitrary distance
7	Inland extent shorelands	Arbitrary distance

Figure 5.3 Boundaries for CZIRM.

CHAPTER SIX

IMPLEMENTATION PLAN FOR CZIRM

The plan, as shown in Figure 6.1, has been structured to maximise the probability that both those who are responsible for program implementation and the target groups of the program, work together in a manner that will ensure that the objectives of CZIRM are attained. The plan has been broken into five phases, with each phase consisting of a information/technology (I/T) aspect (to the left) and a social/institutional (S/I) aspect (to the right).

Although the plan gives the impression of a linear, sequential procedure, it must be realised that each phase is a cause of and also gives effect to other phases. Consequently, tasks in Phase One may be carried out at the same time as some tasks in Phase Two. It is also feasible to miss steps if little benefit can be gained from them, for instance after a number of iterations during the consensus building processes.

In the information/technical aspect, a logical approach to the information requirements of each social/institutional step has been set out. Changes to the information requirements and the technology needed to support those changes is expected as the consensus is achieved in each phase of the S/I aspect. It is intended that at each stage of the S/I aspect, minimum spatial information requirements are met in the form of maps and charts needed for decision making. Decision making needs are to be reflected in the tasks carried out in the I/T aspect of the plan. Consequently the interaction of the concensus building process will affect each stage as the program progresses.

6.1 Phase One - Initiation

The recognition by a nation that there is a need for management of coastal resources usually requires either signs of coastal resource degradation, extensive

destruction from coastal hazards or intense use conflicts. Basically, the tolerance level of a nation's population has to exceed a threshold before action by them begins to take place. That threshold has been reached in most developed countries, but the intention of CZIRM in the Solomon Islands is to be a proactive measure, not a reactive measure. It is therefore hoped that visits from international experts, travel by government personnel to international conferences or strong voices from prominent individuals can preempt the need for a catastrophic event to stimulate awareness and recognition. It may be found that there is no need for a change in present management practices and that all that is required is a tightening of some relaxed government processes, therefore making further investigation unnecessary. This however does not seen to be the case in the Solomon Islands.

Failing this eventuality, through the processes of growing awareness and recognition of coastal problems (conferences, hearings, research, etc.) a lead agency, advocate or spokesperson emerges as a driving promoting the need for action and is nominated by government to coordinate the first steps towards CZIRM. This has clearly been demonstrated in the land information management field where individuals or organisation can be identified as pioneers and 'champions' of the cause. The emergence of a nationally recognised lead agency is crucial to program success. Government approval preferably through the provision of funding for further action must be obtained.

6.2 Phase Two - Compilation and Description

The compilation and description phase for CZIRM is analogous to stock taking in a department store. Assessment of the current products and methods of providing those products to meet the consumer needs must be carried out. The prototype as set out in Chapter Four is the principle method of taking stock of the initial needs for the rest of the design process. It also performs a educational function by introducing modern

information technology to the users. It is at this time that a feasibility study analysing coastal resources, institutional arrangements, management options, broad information deficiencies, present practices and the costs and benefits of a new solution is carried out.

From the social/institutional aspect this is an extremely important process. The working relationships and liaisons developed informally with all interested coastal resource users and information producers at this time, will determine the level of cooperation for the rest of the design process. It is a goodwill stage where the prime concern is to ensure that each individual participant has an opportunity for input. The credibility of the program is established at this phase.

This liaison also is expected to carry over to the initial information gathering processes outlined in the data requirement and acquisition stage and the resource inventory stage. Informal information exchange is expected to occur to facilitate the development of the prototype information system. Identification of initial information requirement with respect to the prototype would then occur. A review of technical papers from five symposium held in the United States (ASP, 1972; Magoon et al., 1978; ACSM, 1979; Edge, 1980; Magoon et al., 1987) reveals a general trend in minimum information requirements specified by coastal managers in the initial development of a coastal management program:

(1) spatial information represented graphically in map form was of most benefit in making resource management decisions;

(1) majority of users preferred map scales of 1:24 000 (1:25 000 metric) or larger for planning purposes;

(2) all required topographic maps;

(3) all required bathymetric maps;

(4) strong support for combined topographic/bathymetric maps was expressed;

(5) at 1:24 000 scale, contour intervals were needed at 1 m for topographic maps and 0.5 m for bathymetric maps;

(6) the demarcation of mean high and low water was required on map products;

(7) for resource plan development the following features are required:
- topographic maps
- bathymetric maps
- administrative boundaries
- land ownership (including customary land)
- water bodies and watersheds
- land use
- geology
- soils
- slope
- vegetation.

6.3 Phase Three - Analysis and Prediction

The informal relationships formed in Phase Two are now formalised in the creation of an interagency consultancy group, made up of 'experts' representative of the user community. To minimise institutional disruption it is considered that a interagency consultancy group (on its own or in conjunction with a prominent ministry) define a clear and precise terms of reference and definition of priority problem areas. The interagency consultation group should be of a consensus nature, in that decisions of the committee are expected to have a binding effect on the member departments and customary groups, though the democratic right to object is still granted since the group should not have mandatory executive authority.

Regional analysis of priority issues are reviewed by the submission of issue papers and review among the interagency expert group. These papers are in response to the feasibility study and the operation of the prototype and are proposed solutions to institutional, environmental, technical and economic problems that have been identified. The draft positional papers become the mechanism for sequential review by the lead

agency and also for minor review by other involved agencies, provincial governments, customary groups and other interest groups.

The development of the terms of reference is an iterative process leading to the acceptance of a definite policy statement achieved through consensus. Consensus building is a particularly important process to the people of the Solomon Islands as it is the traditional way of decision making in village settings and is the only way of ensuring village councils are actively involved in the CZIRM process. Although it is a time consuming process, because there are very few third party groups (e.g. environmental activist) in the Solomon Islands, it is not expected to be as drawn out as it could be in developed countries. The policy statement dictates whether the prototype is to discontinued

6.4 Phase Four - Plan Preparation, Internal Review, External Review and Optimisation

Information for this process is derived from the resource inventory and resource mapping and analysis stages. From analysis of basic digitised maps compiled from the prototype and maps compiled from remote sensing imagery, maps depicting environmental conditions can created. From these a coastal resource opportunity and constraint maps can be developed. These maps would cover the following themes : marine resources, seismic hazards, high wind zones, wildlife habitats, wetlands, archaeological areas, forest resources, coastal erosion and slope stability.

The resultant policy statements will determine whether a plan for CZIRM will involve the formation of totally new approach, revision of existing legislation or the continuance of the existing legislation. In the first two scenarios a administrative authority is designated to oversee the plan development. This authority should simply be a consolidation of the interagency consultancy group. Alternative institutional,

organisational, economic and technical arrangements are considered with respect to the derived policy statements. These are circulated for internal review, before circulation among external interest groups. Through this process the alternatives are optimised until again a consensus agreement is reached on the implementation procedure.

6.5 Phase Five - Implementation and Assessment

The implementation plan includes the designation of areas under three policy units. These policy units are defined as preservation, conservation and utilisation areas. The policy units are a derivative of maps depicting land/marine suitability and capability. The policy units are intended to delimit the coastal zone and differentiate between areas whose geophysical, biological and cultural features imply differing objectives regarding their use and further development. Each unit represents a particular emphasis, limiting the types of use and the extent of development which can occur within it.

Implementation of a CZIRM plan, whether through a new separate program or through the revision of existing statutes, involves considerable training of management and support staff for specific program areas. New equipment may require restructuring of staff and physical organisation as well as relocation. Implementation also should involve a public information program, setting out the new policy in short and concise terms and how this would affect the social well being as a whole.

Assessment, although placed here as a final evaluation criteria, has been an intangible part of each stage. The plan preparation is based on user assessment at every phase through the building of consensus. Consensus implies that the user needs have been meet or at least that there is satisfaction with a compromise that has eventuated. The final assessment involves the evaluation of information/technology aspect and the social/institutional aspect as a working functional unit, and the performance of both against the stated policy objectives. A clear indication of the effectiveness of the program

is a comparison of the present state of the environment to environmental conditions before the program. The program assessment will determine whether any adjustments need to be made. These may include the absorption into another program, the creation of a separate program, the continued operation of the selected plan or the abandonment of the new management techniques. In all four cases, the continued evolution of the program must be ensured by the periodic revision of the program from phase three.

CHAPTER SEVEN

CONCLUSIONS

With the current environmental consciousness of governments, industry and the public, the potential for successful implementation of a CZIRM program has never been more feasible. The need for management of coastal resources has never more apparent. The types of problems faced by developing island countries in the SWP basin are encountered through the economies of most countries and are not exclusive to the coastal zone. However, they are accentuated by the size of the islands and the environmental fragility of its coastal areas.

Enactment of CZIRM programs ensures a level and type of development for the coastal zone and its resources that is consistent with the continuing productivity and vitality of the natural and human systems upon which the productivity of the area is based. CZIRM assumes its importance for developing island countries because of the unusual productivity of the coastal area and its ecosystems and because of the extensive and growing use of these areas for settlement, industry, trade, recreation and tourism. Coastal systems are complex and the trade off between various constraints and options for resource development are recognised, ranked, evaluated and employed as inputs to the strategic planning process. Insular vulnerability therefore is kept within lower risk ranges and manageable bounds.

A CZIRM program is a reaction against narrowly based incremental decision making which pervade most projects in coastal areas. However, it is not equivalent to conventional comprehensive planning which, in an attempt to be rational and allencompassing, tends to produce plans that are long in coming, exceedingly broad in scope, overly technical in orientation, and often incapable of securing the agreement of the

many interests involved. CZIRM requires the accommodation of three other major perspectives. A technical view enables the choice of appropriate tools used in assembling a sound base of information. An institutional perspective uncovers organisational barriers, constraints and opportunities which pose the major obstacle to CZIRM. The social perspective looks at it as a means of enhancing positive social (and economic) change.

A CZIRM program combines a mix of incremental and comprehensive management approaches. By making coastal management strategic, it pays explicit attention to the institutional and organisational environments, focusing analysis early, leaning planning towards action and making it an ongoing process. By imposing an interactive aspect to the technical analysis from the very beginning of the project, focus and consensus is achieved among program managers as well as those affected by its implementation.

There are numerous coastal management programs enacted through out the developed world which have dealt with problems similar to the potential resource management problems facing the Solomon Islands. However, different social conditions and significant economic pressures necessitate different management priorities, perspectives and techniques.

The use of a low cost prototyping method has been put forward as alternative to expensive system analysis methods in determining user information requirements. The proposed solution to the demands of CZIRM decision making needs for information would allow the development of an appropriate design structure and set of system specifications techniques which enable the CZIRM organisation to establish its information requirements before the need to spend excessive amount of money on a binding and possibly inadequate technical solution.

The implications of the discussed concepts for the surveying profession's involvement in CZIRM for the Solomon Islands or other developing SWP island countries, will most likely be manifested in foreign aid and technical assistance programs. It is important that the profession understands the short and long-term implications that a development project will have on the traditional insular systems. This is particularly vital for the sustained use of resources of the coastal zone and for the continued existence of the island communities.

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APPENDIX I

COASTAL ZONE PROBLEMS

Coastal zone problems can be separated into two distinct groups (Englander et al., 1977). The first group are socio-economic problems which are a result of dissatisfaction with a natural resource state. The second group are institutional issues, which refer to the established laws and customs and the administrative structure needed to support them. The following list is a compendium of a report sponsored by United States National Oceanic and Atmospheric Administration prior to the passage of the United States CZMA of 1972.

Socio-economic Problems

(i) Intense use conflicts among competing uses.

The principal conflict is between estuarine preservation values and economic development demands. Another major conflict is between recreational activities and industrial, commercial and residential development. Conflicts occur because of self interested priority by developers irrespective national interests.

(ii) Increasing population growth with residential, commercial and industrial development pressures.

The increase in population in the coastal zone is accompanied by rising pressure for housing and business development, tourist and ocean front facilities, port and harbour facilities, business support industries and recreational opportunities.

(iii) Extensive environmental pollution.

Three key sources of pollution affect the coastal zone:

- industrial and municipal sewage, combined with agricultural effluents
- oil spills from tankers, offshore production and natural seepage in harbours.
- thermal pollution from electrical generating facilities and industrial plants and wastes from nuclear power plants.

(iv) Destructive dredging, filling and bulkheading

The prime reasons for these activities are navigational improvements, stream diversion, water projects and shell, sand and gravel mining in the case of dredging. The main reasons for filling and bulkheading are residential and commercial development.

(v) Destruction of coastal habitat and degradation of fish and wildlife resources.

The destruction of coastal wetlands is irreversible. The cause of the destruction can be attributed to five primary factors:

- water management and coastal engineering projects.
- residential and commercial development
- industrial and municipal wastes
- extensive dredging and filling
- mismanagement of biological resources.

(vi) Limited public access and recreational opportunities.

The total amount of shoreline of a coastal state compared to the small amount accessible to the public is quite small in some areas. Reasons put forward as causing these problems are:

- recreational opportunities are being destroyed by pollution and habitat destruction

- local and state governments lack money to acquire recreational lands
- private beach development is restricting public access
- recreational values do not receive adequate representation in the market place.

(vii) Aesthetically displeasing development.

(viii) Damage to shoreline environment and development.

(ix) Inadequate economic development.

(xi) Boating and navigation hazards.

Institutional Problems

(xii) Lack of co-ordination among public agencies

This problem arises out of the overlapping and fragmented management responsibilities of a large number of public agencies involved in different aspects of coastal management as well as jurisdictional conflicts among federal, state and local authorities over management control.

(xiii) Insufficient planning and regulation authority.

Geographic limitation of local jurisdictions, lack of zoning powers or other legal devices and the partial nature of programs are all identified as the reasons for the inability of governments to manage coastal resources effectively.

(xiv) Lack of clearly stated goals.

Federal and state governments lack clear goal statements and policies concerning the use of coastal resources. Conflicts in goals often arise, compounding the resultant problems.

(xv) Insufficient data base and lack of information for decision making.

There is a lack of basic information for effectively managing the coastal zone, as well as monitoring capabilities and poor communication between researchers and decision makers.

(xvi) Little understanding or knowledge about coastal ecosystems.

There is a lack of adequate funding for carrying out coastal ecosystem research.

(xvii) Complex, conflicting and confusing laws.

(xviii) Little awareness or concern with coastal problems.

(xix) Primitive analytical tools and predictive methodologies.

Three deficient areas are recognised:

- lack of analytical modelling methods;
- static rather than dynamic planning methods;
- inability to evaluate the benefits and the costs of non-market public goods.

(xx) Governments of all levels lack funds to manage the coastal zone.

Governments lack funds in four main areas:

- money to implement local coastal zone management programs;

- support for coastal ecosystem research;
- money to contract management expertise to perform necessary planning and evaluation;
- funds to acquire public land for preservation and recreation.

(xxi) Lack of properly trained and educated management personnel.

(xxii) Dominance of short term planning over long range planning.

Two main causes can be identified:

- the free market tradition of allowing individual owners to use their own lands as they saw 'fit'.
- desire of short term profit by developers, governments and public agencies.

(xxiii) Resource decisions are being made on the basis of economic considerations to the exclusion of ecological data.

(xxiv) Limited public participation in decision making.

(xxv) Environmental regulation stifle economic enterprise.

Figure I.1 shows that there is a inter-relationship between the socio-economic problems, as one may be the cause of or be a contributing factor to, detrimental effects on the coastal zone. The same can be shown of institutional problems, where lack of governmental co-ordination leads to ineffective planning programs for the environmental well being and the constructive economic exploitation of the coastal zone (Figure I.2). Further analysis shows that institutional problems are themselves the cause of much of the

socio-economic degradation of the coastal zone (Figure I.3). It is the understanding of the underlying causes of problems that exist in the coastal zone that will allow effective coastal zone integrated resource management decisions to be made. Action within a coastal zone integrated resource management program becomes much more effective when the causal chain, from the outcome effects back to the initial institutional arrangements which have allowed the manifestation of the problems, is traced.

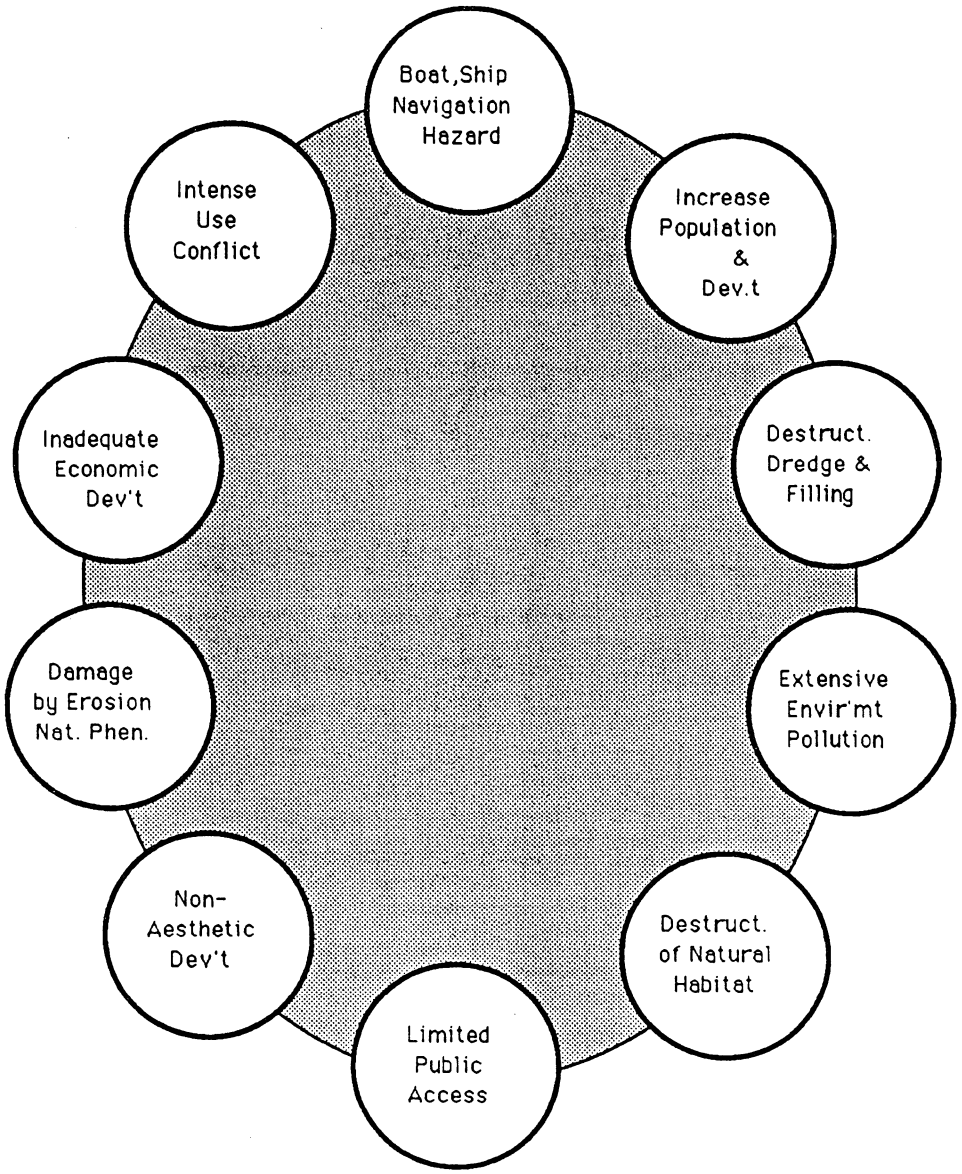


Figure I.1 Socioeconomic problems which are the cause of or further contribute to coastal zone problems.

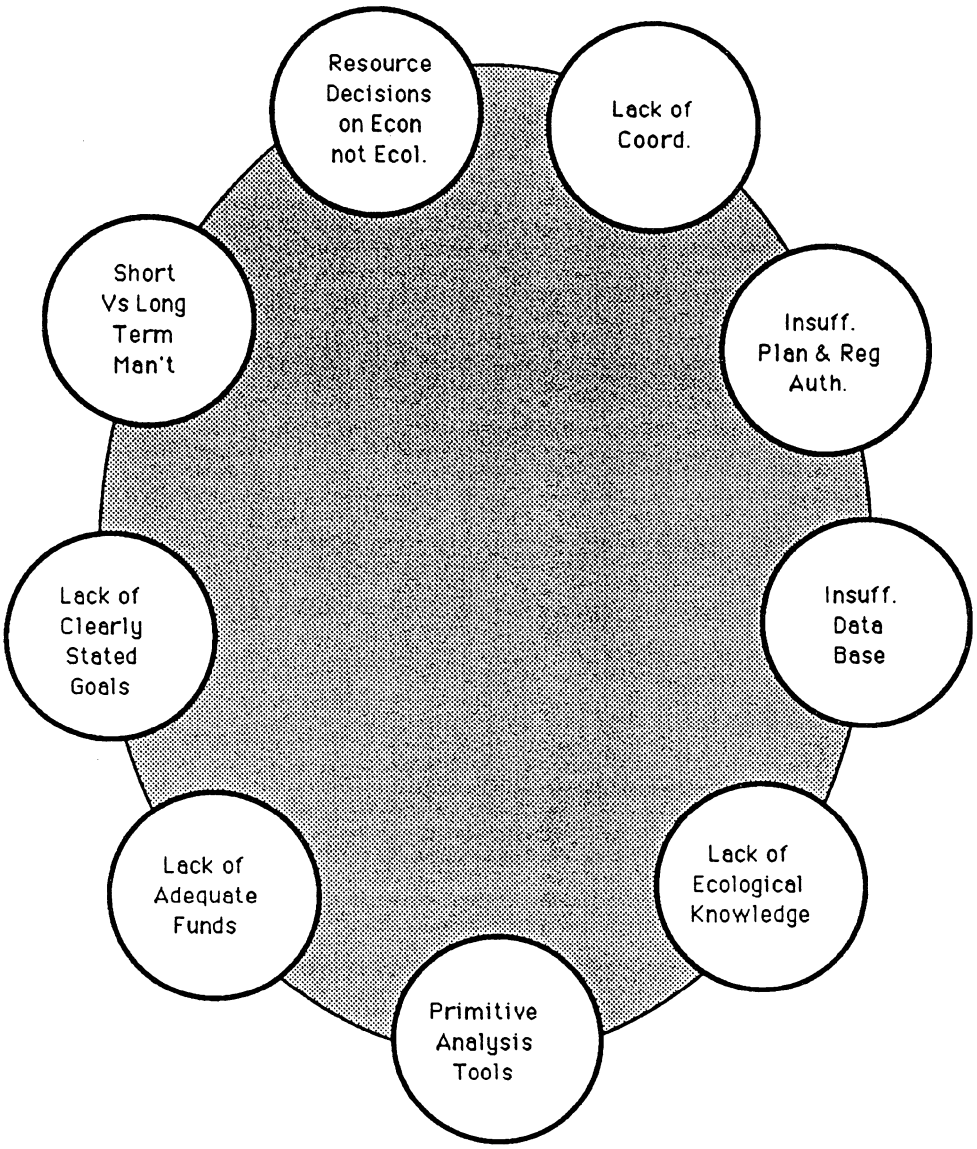


Figure I.2 Institutional problems which are the cause of or contribute to further coastal zone problems.

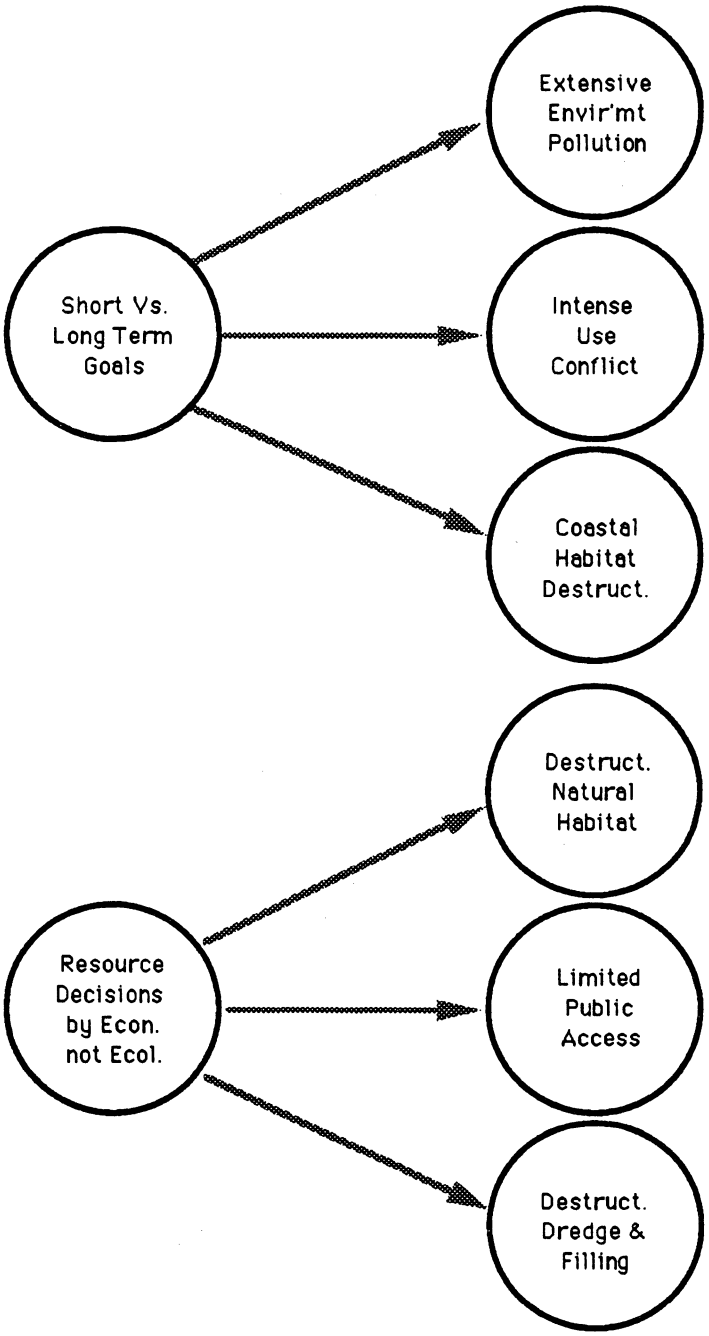


Figure I.3 Socioeconomic problems that exist as a direct result of institutional arrangements.

APPENDIX II

MAPII™ PROTOTYPE

An information system prototype has been described as an early version of a system that exhibits the essential features of the later operational system (Ezigbalike, 1988). MAPII allows the user to explore the possibilities that a full scale GIS may be capable of performing. To show some basic functionality of MAPII the following data sets have been created and transformations performed in response to specific questions.

(1) Given a elevation relief map, produce a contour map.

Procedure:

a. Isolate cells which are not adjacent to cells of another value.

SCAN *ELEVATION* PROPORTION

Result is *SCANNED PROPORTION.*

b. Create a mask to be used to mask out none-boundary cells.

RECODE *SCANNED PROPORTION* ASSIGNING 100 TO 100

Result is *MASK.*

c. Isolate the none-boundary elevation cells.

COVER *ELEVATION* WITH *MASK*

Result is *MASKED ELEVATION.*

d. In order to be effective a non-Void value has to be used for masking. However for the next few steps it is essential to Void the masked areas.

RECODE *MASKED ELEVATION* ASSIGNING VOID TO VOID THROUGH 100 CARRYOVER

Result is *VOID MASK ELEVATION* .

e. The scanning mask must now be prepared. A duplicate of *MASK* is created and is called *SCAN CELLS* . Value VOID is changed to 1 and value 100 to VOID. This creates a inverse mask which will be used to guide the scanning process.

f. The contour map is created in the following manner.

SCAN *VOIDED MASK ELEVATION* AVERAGE DIAGONALLY AROUND *SCAN CELLS*

The AVERAGE qualifier gives the contour lines an average value close to the actual contour interval. The DIAGONALLY modifier specifies a square window of 3*3 cells. AROUND specifies the cells that are subject to the operation. Result is *SCANNED AVERAGE* .

g. Finally a large recode operation defines the contour values exactly.

Result is *CONTOUR*. The operation was complete in approximately 3.5 hours of process time.

(2) Given a municipal street map (imported from digital ARC/INFO vector file) and Landsat Thematic Mapper data (Pazner, 1989) covering the same area, rubber sheet the imagery to fit with the topographic map. The process involves correcting the imagery for rotation, translation, scaling, projection and other distortions. The same operation could be performed with remote sensing images from Coastal Zone Colour Scanner, SPOT, NOAA or GOES satellites. MAPII has the ability for limited image analysis, but is best carried out using a colour MacintoshII computer.

Procedure:

a. Two control point maps, one to define the geometry of the source map *LANDSAT THEMATIC MAPPER BAND3* and one to define the geometry of the reference

map, *STREETS* , are needed. Each map is duplicated and values are shifted to leave values 1 to 19 vacant for control point numbers.

Result are *LANDSAT+CONTROL POINTS* and *STREETS+CONTROL POINTS* .

b. Both maps are displayed and control points are selected that are easily discernable on both maps. In this case 7 control points at road intersection are selected. The matching control points, represented by one cell, are valued from 1 to 7 on each map.

c. The rubbersheeting is then performed.

WARP *LANDSAT THEMATIC MAPPER BAND3* ORDER2 BASED ON *LANDSAT+CONTROL POINTS* USING *STREETS+CONTROL POINTS* .

ORDER 2 modifier is used for operation involving less than ten control points. The result is *RECTIFIED LTM3*.

d. A visual check of the transformation operation can be accomplished by superimposing *STREETS* on *RECTIFIED LTM3*

COVER *RECTIFIED LTM3* WITH *STREETS*

The resulting map, *STREET/LTM3* , would suggest that control point selection may have been in error. Also, more control points could have ensured a closer fit.

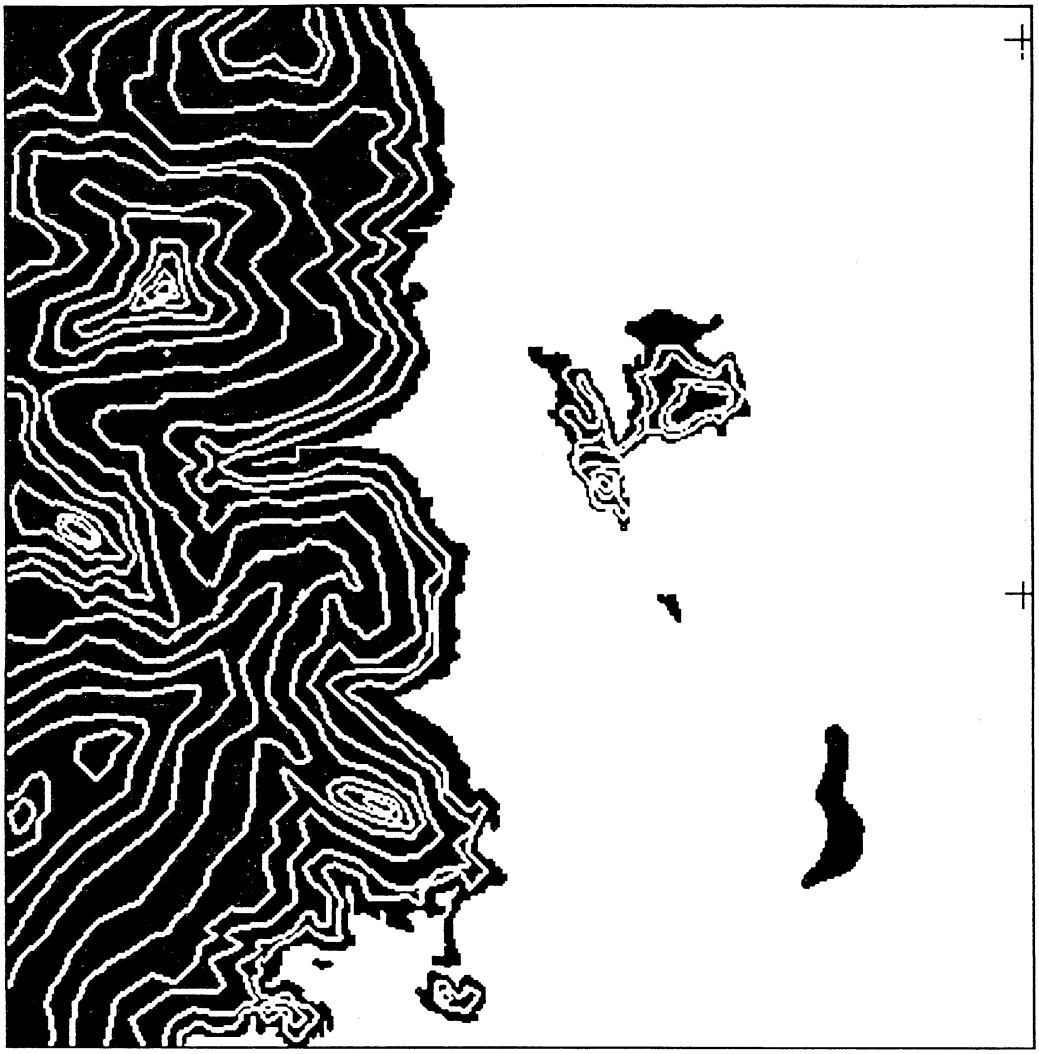
Data Set One

ELEVATION

	VOID	SEA		125	113		300	256
	10	0 -		150	138		350	326
	50	25 -		175	163		400	376
	75	63 -		200	188			
	100	88 -		250	213			

SCAN PROPORTION

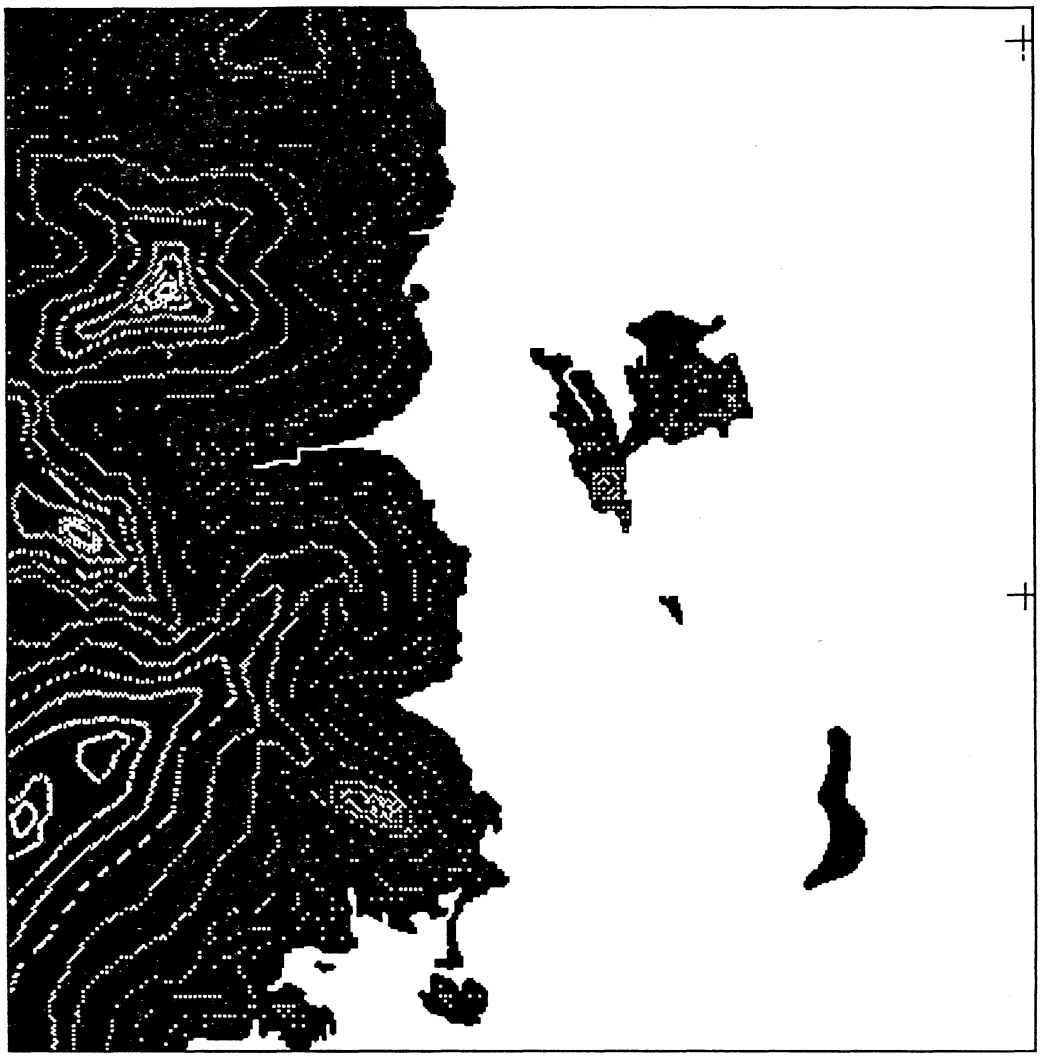
MASK



= 2000 Metres 1:162992

VOID 100

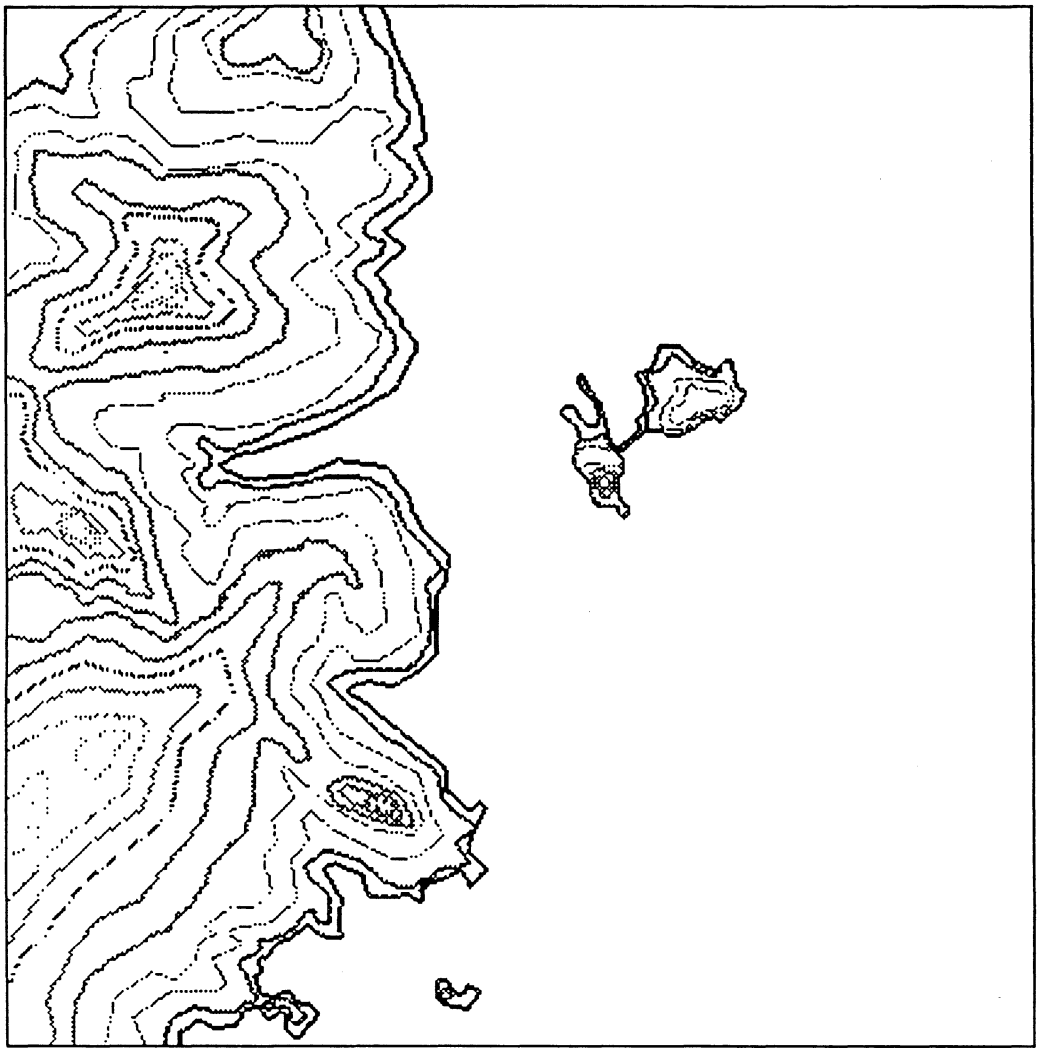
MASKED ELEVATION



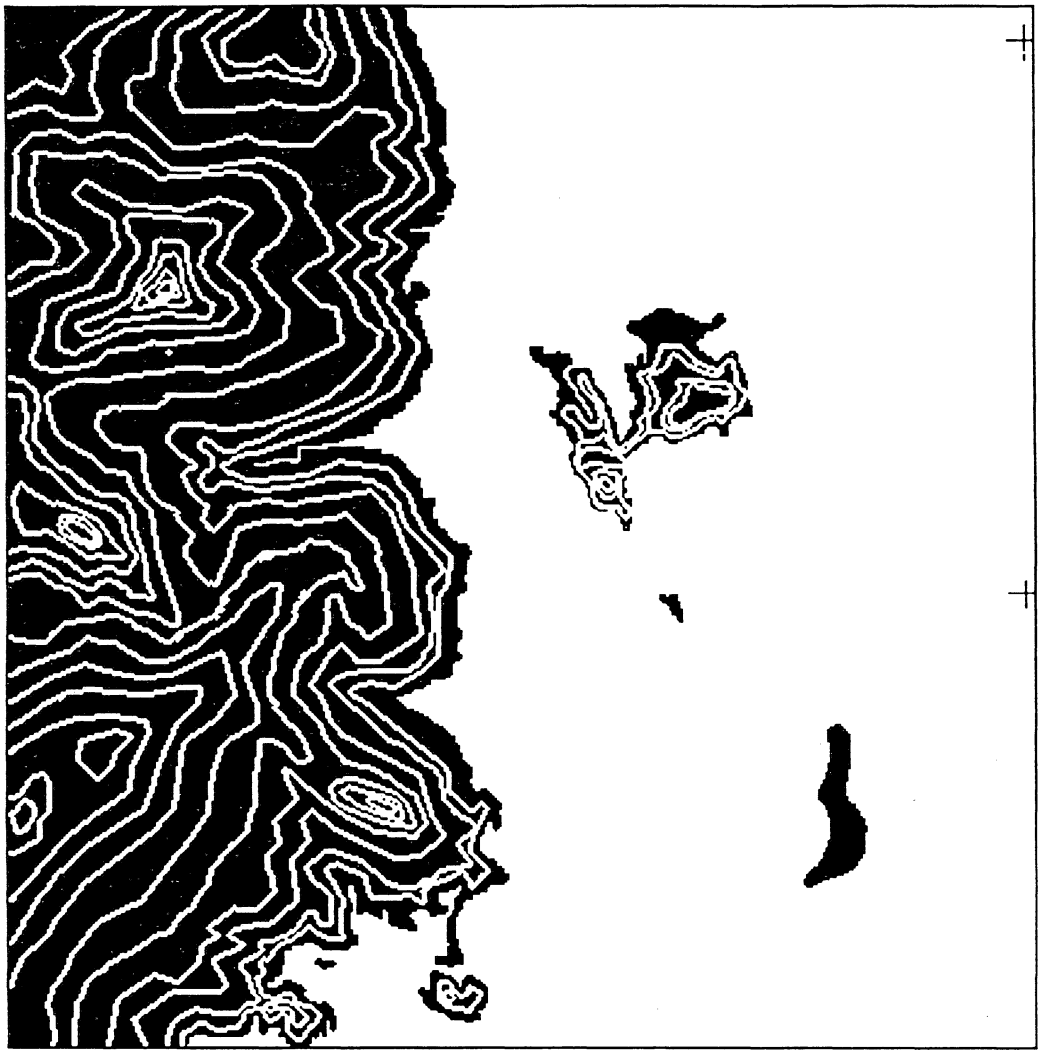
= 2000 Metres 1:162992

	VOID		125		300
	10		150		350
	50		175		400
	75		200		
	100		250		

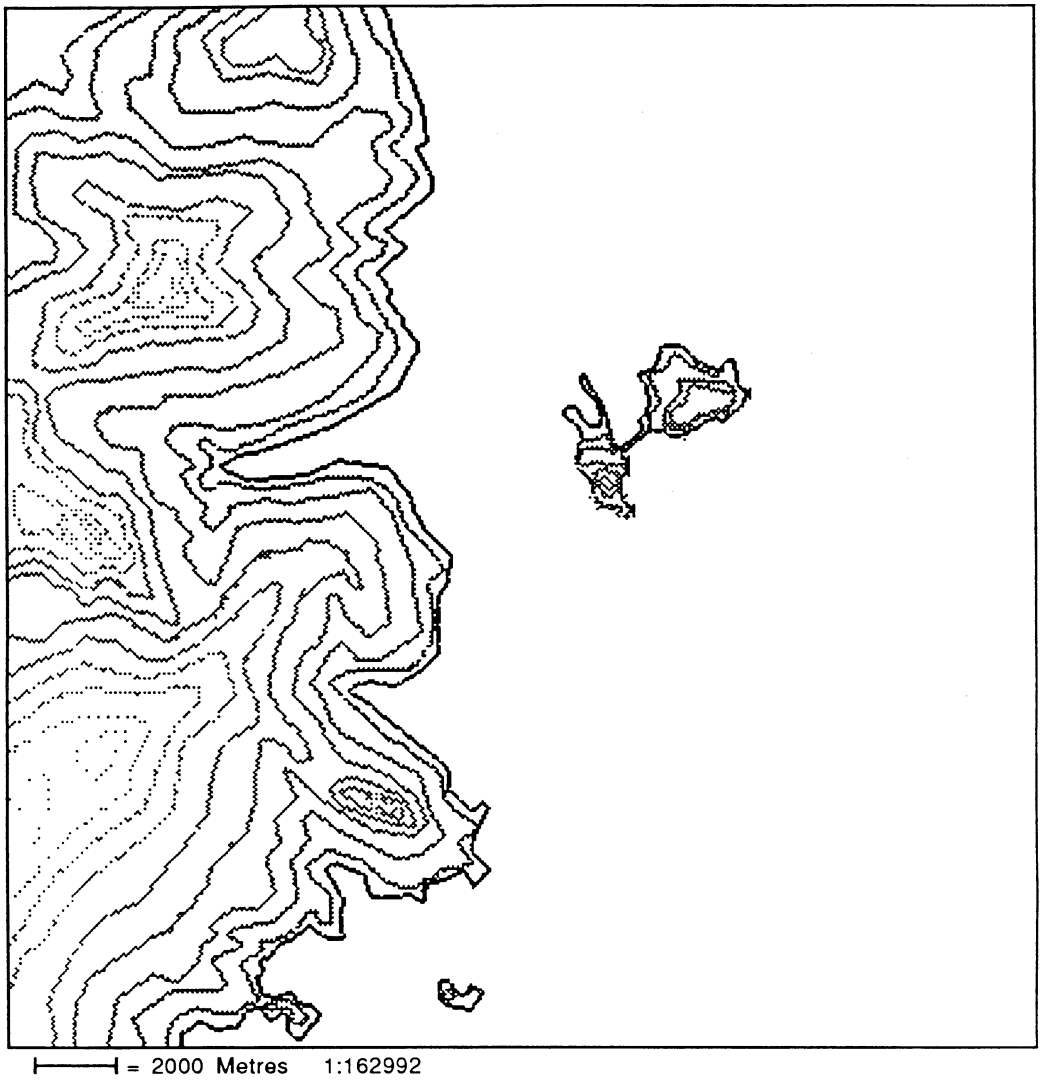
VOID MASK ELEVATION

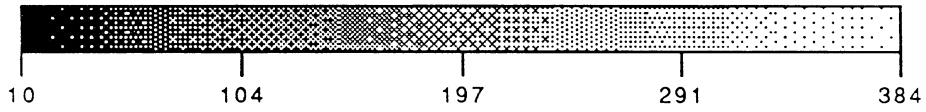


SCAN CELLS

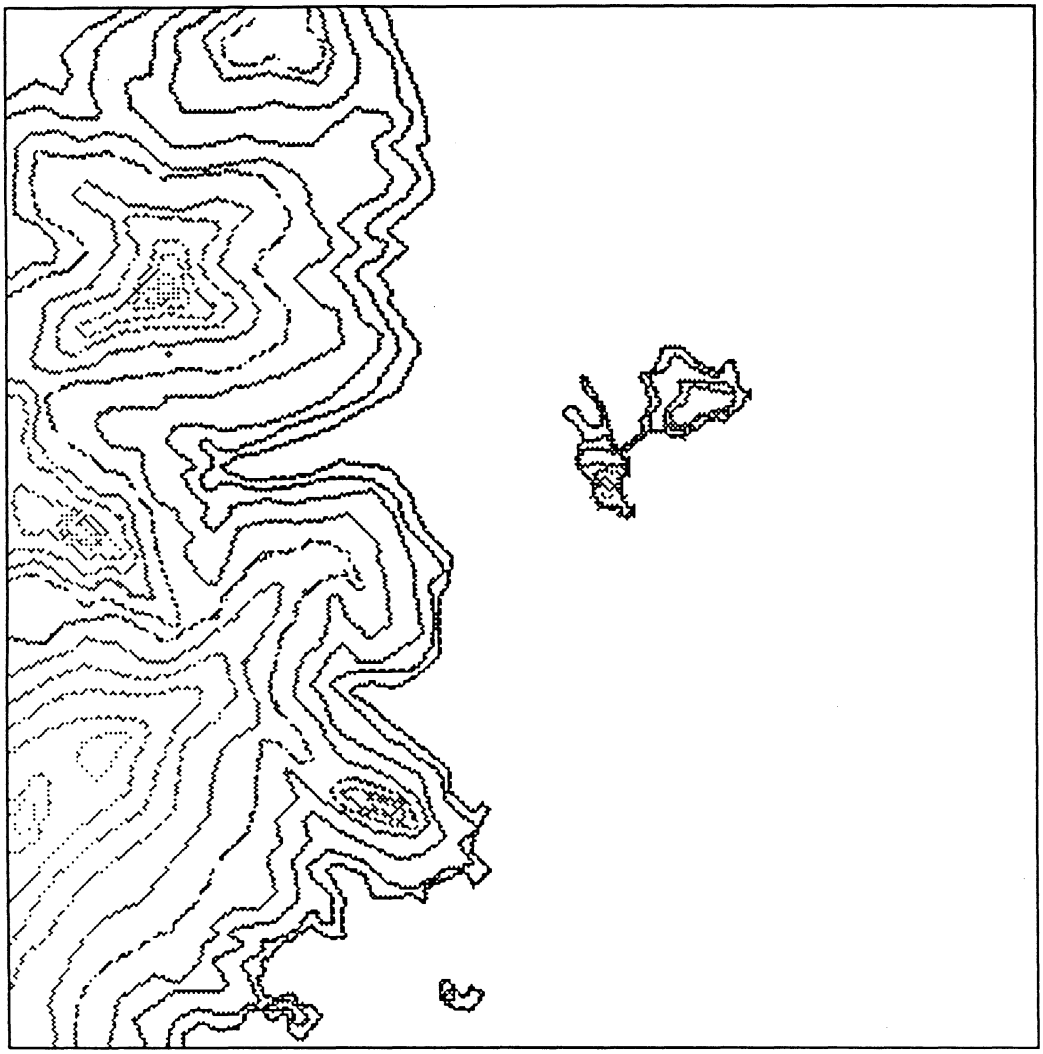


SCAN AVERAGE





CONTOURS

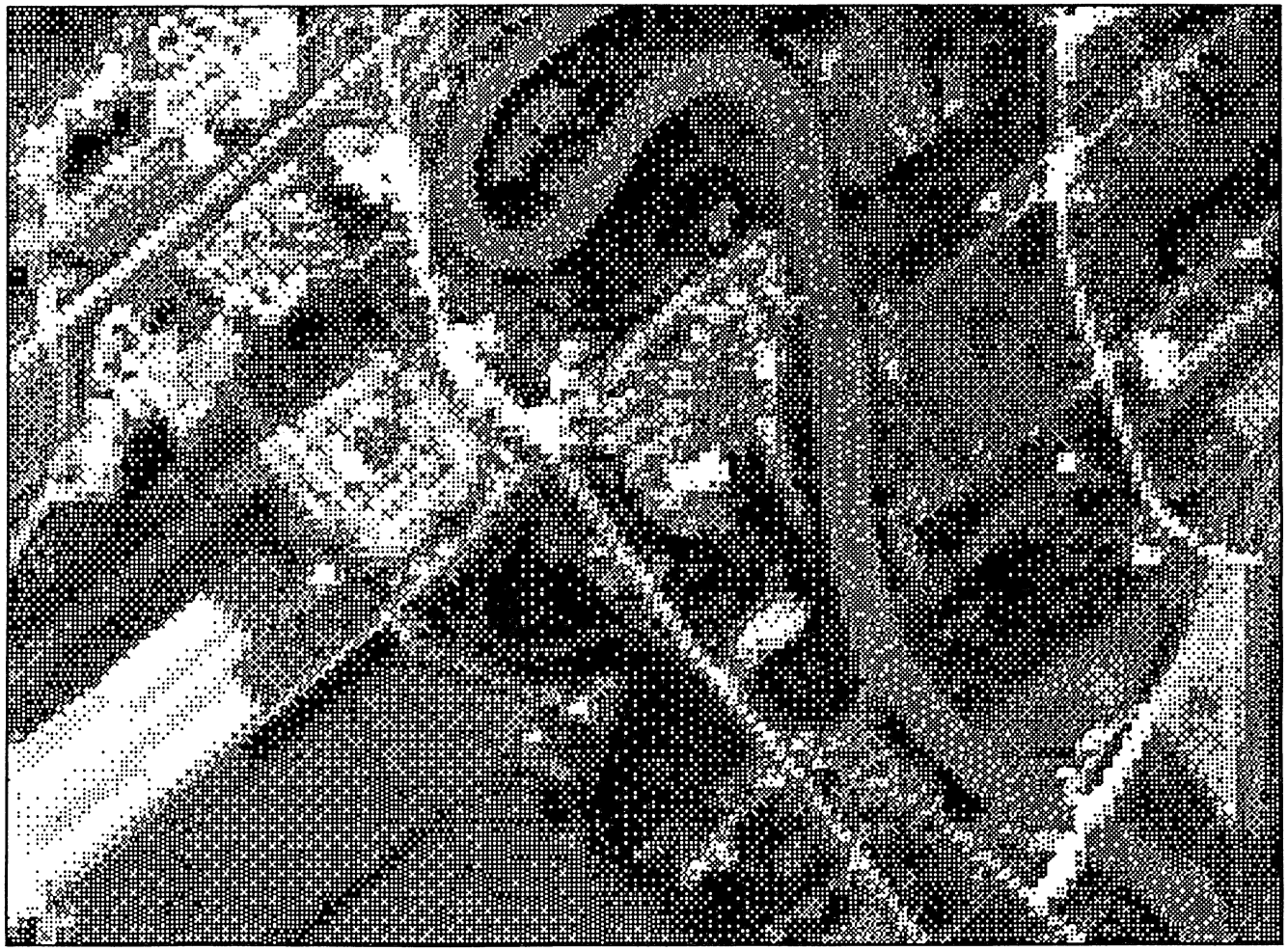


= 2000 Metres 1:162992

VOID	125	300
10	150	350
50	175	400
75	200	
100	250	

Data Set Two

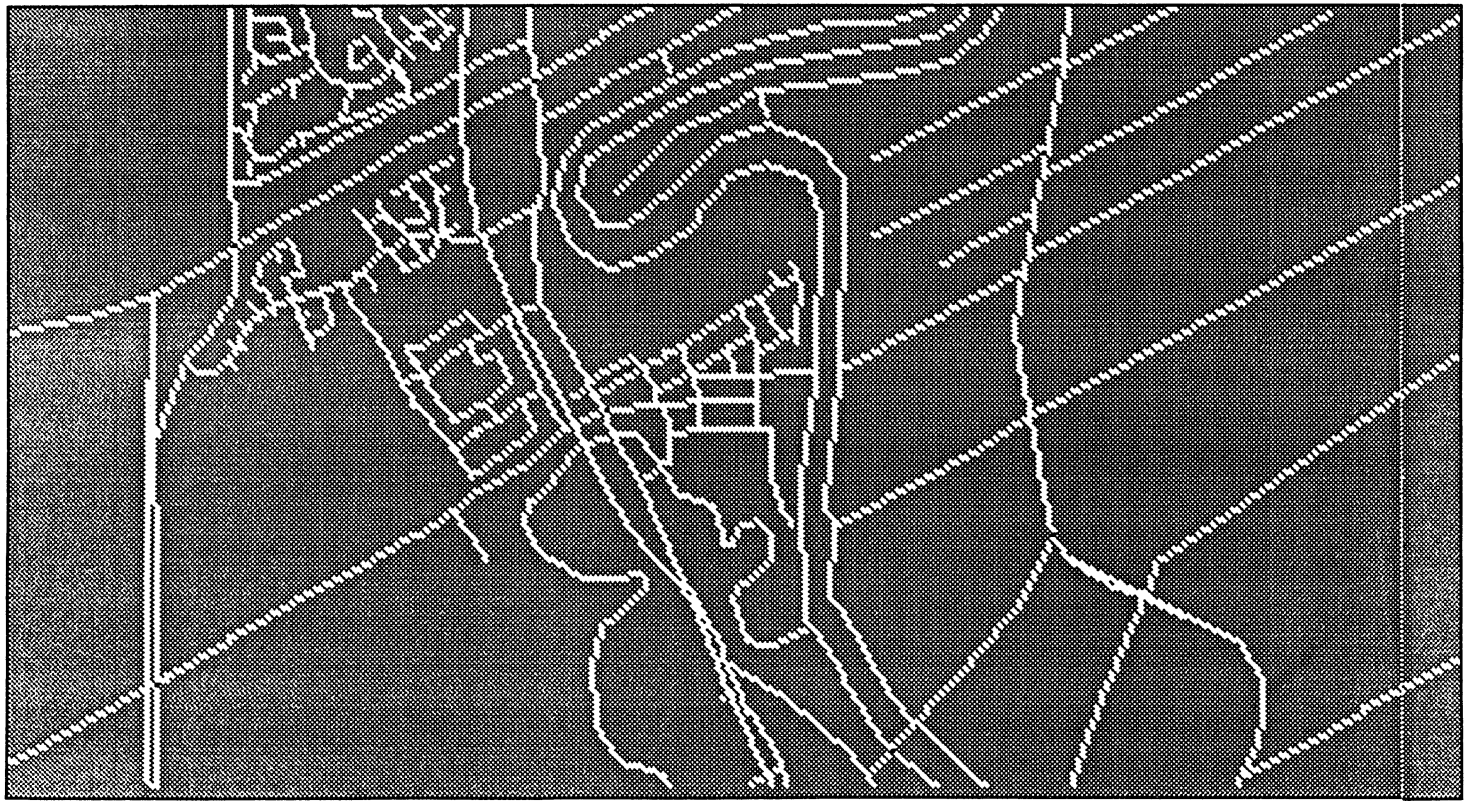
Landsat Thematic Mapper Band 3



= 300 Metres 1:21260

Landsat+Control Points

Streets+Control Points



LTM3 Rectified

= 500 Metres 1:42520

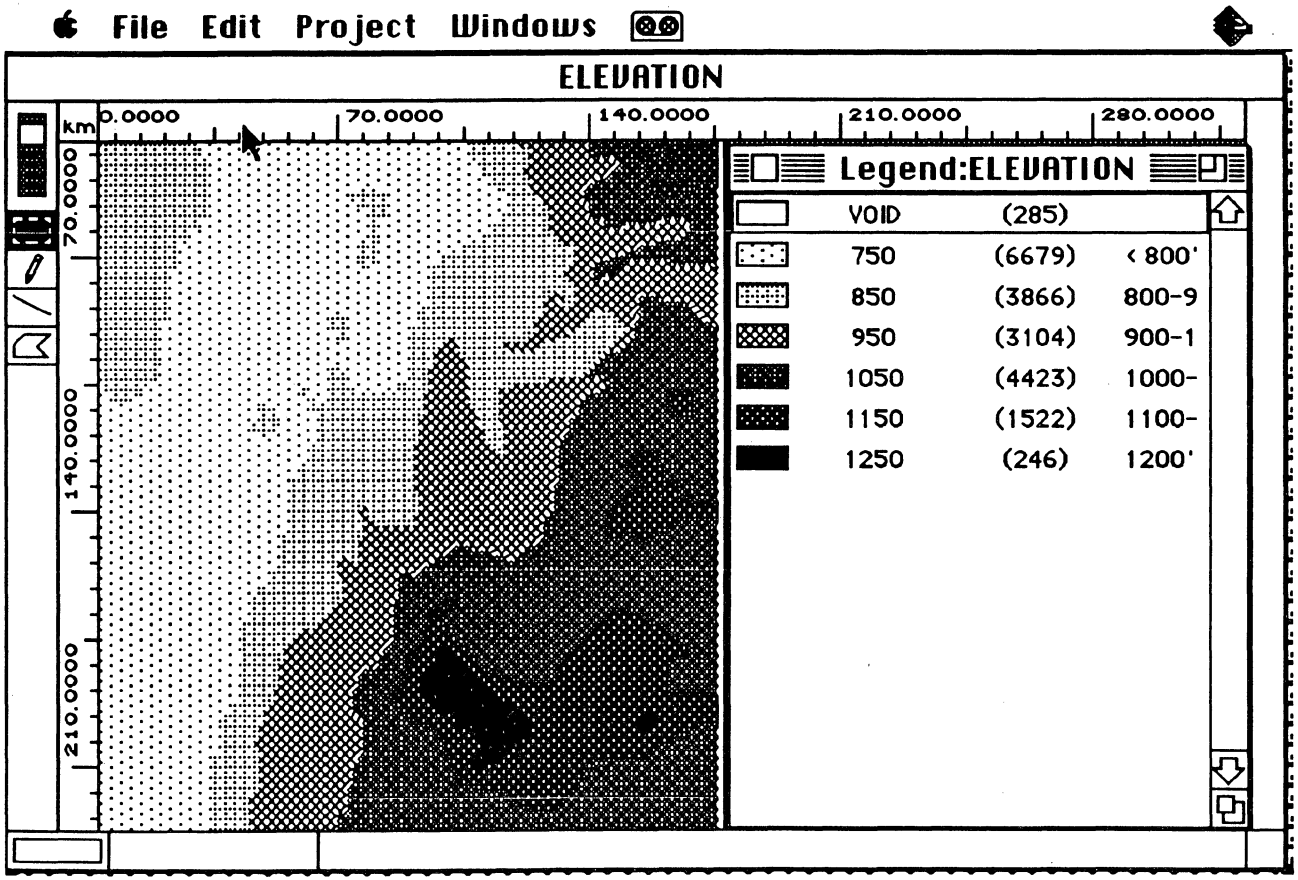
Street/LTM3 Overlay

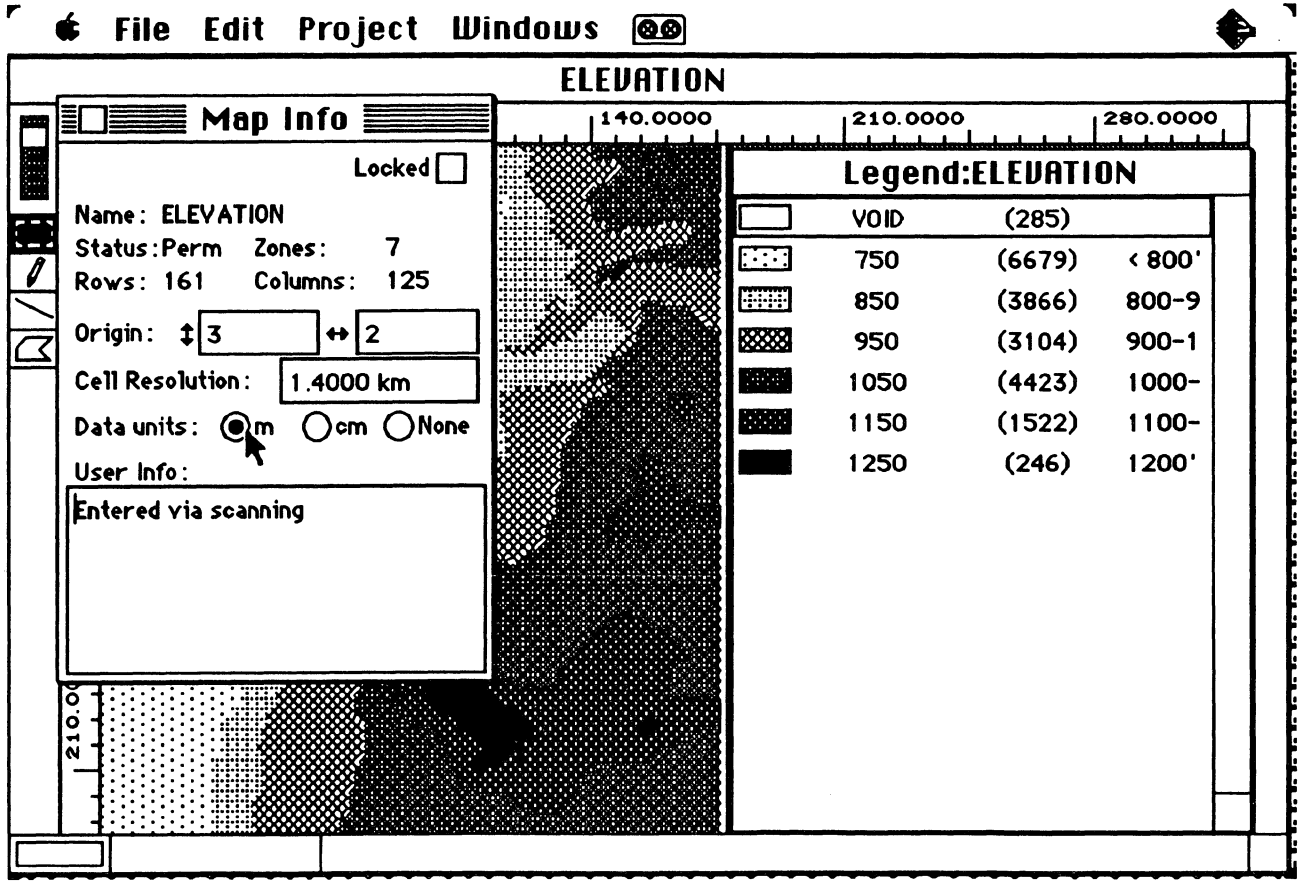
⊢——⊣ = 500 Metres 1:42520

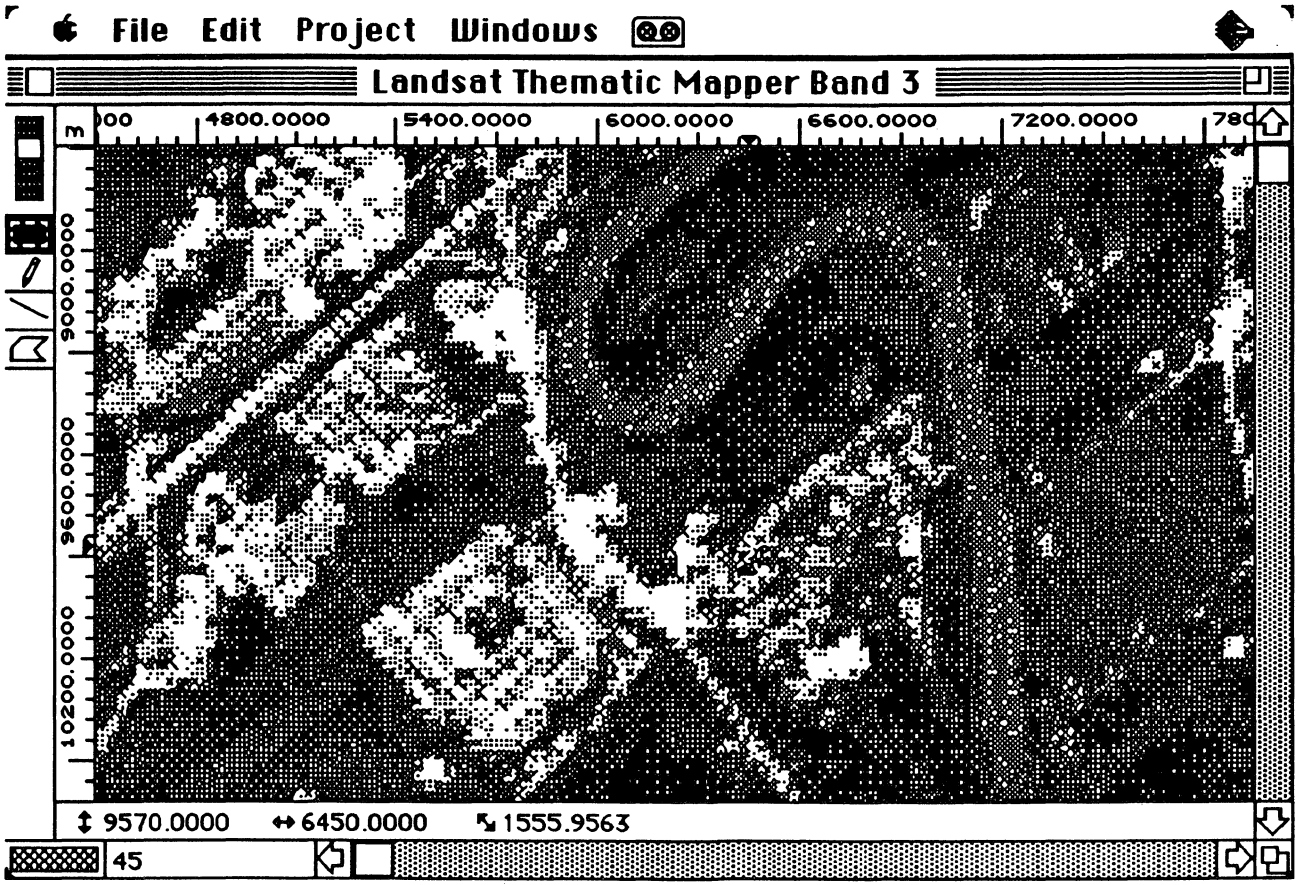
APPENDIX III

MAPII™ USER INTERFACE

The graphical user interface is the most important, but frequently the most neglected, component of any information system. If the user finds interacting with a system confusing and unfriendly, the probability of their future use of the system drops dramatically. MAPII provides a standard Macintosh user interface to the application of the system. This type of interface has been found so successful as a front-end to applications, that many most GIS vendors are developing a similar menu type approach for their systems. Large computer companies such as IBM are also recognising the importance of a user friendly graphical interface and so have introduced a program called Windows 3, which gives the operating system a Macintosh-like look to it. The ability to decide what functions are essential for a particular task (e.g. data digitising) and display only those functions to the user through a Macintosh -like menu, is essential for effective, efficient and productive application of a system. The following screens show the interface to MAPII, upon which a working system could be modelled.


File Edit Project Windows
ELEVATION
km
0.0000
70.0000
140.0000
210.0000
280.0000
70.0000
140.0000
210.0000
Legend:ELEVATION
VOID (285)
750 (6679) < 800'
850 (3866) 800-9
950 (3104) 900-1
1050 (4423) 1000-
1150 (1522) 1100-
1250 (246) 1200'


File Edit Project Windows
ELEVATION
Map Info
Locked
Name: ELEVATION
Status: Perm Zones: 7
Rows: 161 Columns: 125
Origin: 3 2
Cell Resolution: 1.4000 km
Data units: m cm None
User Info:
Entered via scanning
140.0000
210.0000
280.0000
210.0
Legend:ELEVATION
VOID (285)
750 (6679) < 800'
850 (3866) 800-9
950 (3104) 900-1
1050 (4423) 1000-
1150 (1522) 1100-
1250 (246) 1200'


File Edit Project Windows
Landsat Thematic Mapper Band 3
4800.0000
5400.0000
6000.0000
6600.0000
7200.0000
9570.0000
6450.0000
1555.9563
45

VITA

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