

Fiji

National Report to UNCED

National Reports to the United Nations Conference on Environment and Development (UNCED) were prepared under the direction of the National Task Forces in 12 Pacific island countries with the financial and technical assistance of the Asian Development Bank and United Nations Development Programme. This assistance was coordinated by Gerald Miles through the South Pacific Regional Environment Programme (SPREP). For Fiji this report was drafted by Mr Bhaskaran Nair, Mr Dick Watling and Mr Stuart Chase, endorsed by their government for presentation to the United Nations.



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South Pacific Regional Environment Programme (SPREP)
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UNITED NATIONS CONFERENCE ON
ENVIRONMENT AND DEVELOPMENT

REPUBLIC OF FIJI NATIONAL REPORT

Prepared and Edited by
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FOREWORD

I am pleased to submit this National Report as Fiji's contribution to the United Nations Conference on Environment and Development. The Report was officially endorsed by the Government of the Republic of Fiji at the Cabinet Meeting held on 23 July 1991.

Preparation of the National Report for UNCED has been timely, for Fiji is currently in the process of preparing a National Environment Strategy, due for completion in August 1992. Although Fiji is well endowed with natural resources, which have enabled it to become the most progressive and developed of the South Pacific small island nations, we are very much aware of the need to guide our course along the path of sustainable development. It is for this reason that we have initiated a national environmental planning process.

Of course, striking a balance between progressive economic development goals to raise our living standards, on the one hand, and conserving our environmental resources, on the other, will not be an easy task. Human intervention in these islands stretches back thousands of years and we already live with the consequences of man-made environmental change. Further changes are inevitable as we develop the nation. However, it is our goal to strike that essential balance between development and wise use and management of our diverse, but limited, environmental resources.

Looking at the broader perspective, Fiji is very much aware and concerned that it is, along with other island nations of the South Pacific, subject to the environmentally negative activities of the industrialised countries - principally the impacts of climate change such as rising sea levels.

I hope that those nations and other parties participating in the UN Conference on Environment and Development will not only consider the status of individual countries but also resolve some of the outstanding global issues which confront us. We in Fiji will strive to do our part.



Tomasi Vakatora
Minister for Housing and Urban Development

Foreword

Pacific island countries are collectively responsible for a significant proportion of the Earth. Pacific islanders do not take this responsibility lightly and have therefore put considerable effort into the preparations for the United Nations Conference on Environment and Development (UNCED). This National Report to UNCED is part of that effort and, along with national reports from 13 other Pacific island developing countries, has formed the basis of the Pacific region's preparations for UNCED. As part of these regional preparations, National Reports and other relevant information concerning sustainable development, have been synthesised in *Environment and Development: a Pacific Island perspective* and *The Pacific Way: Pacific Island Developing Countries' Report to UNCED* which presents a summary of the issues and constraints to sustainable development alongside the regional consensus on the priorities for further action.

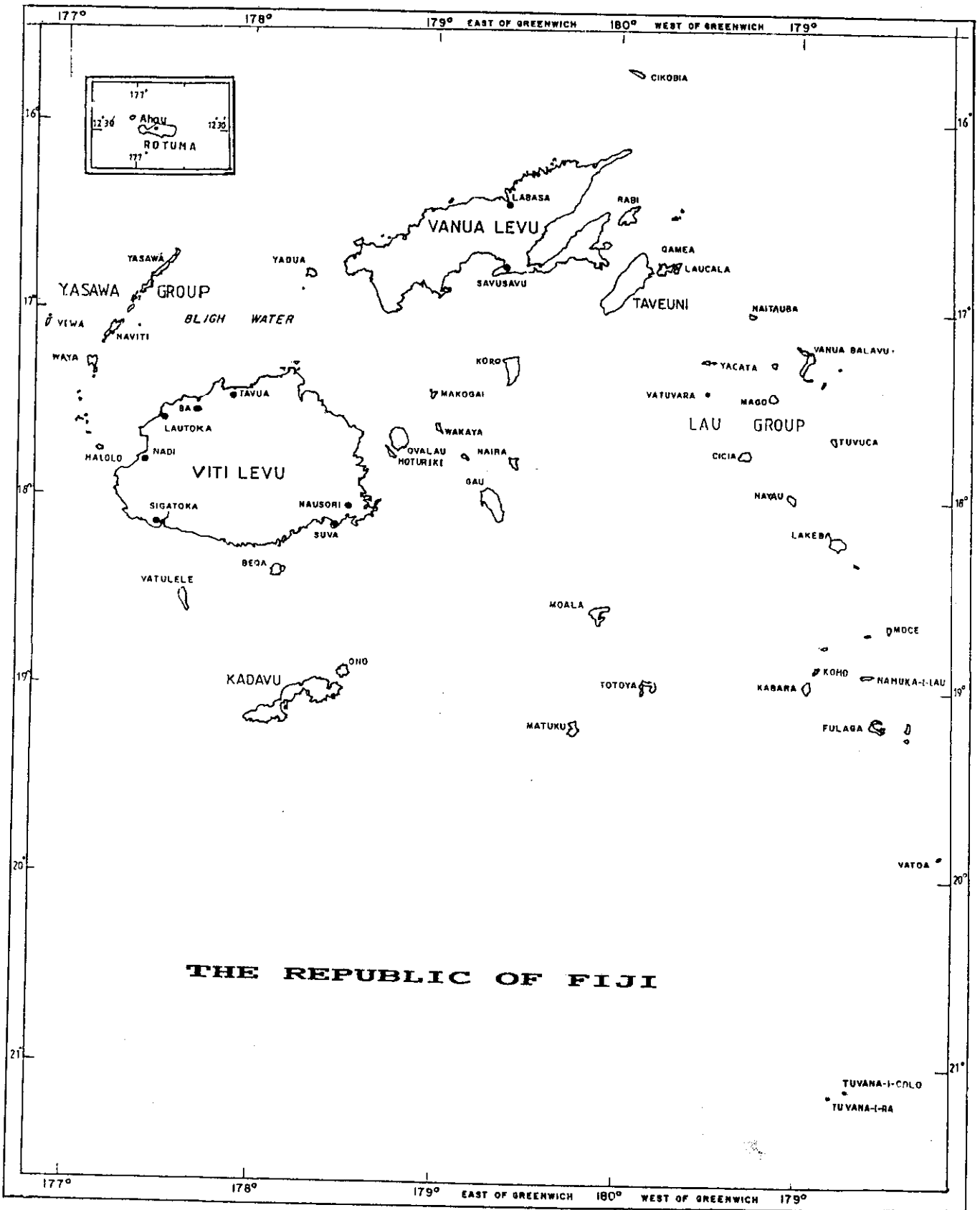
At our third Inter-governmental Meeting in Noumea, New Caledonia, 1990, members of the South Pacific Regional Environment Programme (SPREP) called for assistance in their preparations for UNCED. This call was answered by the Asian Development Bank (ADB) and the United Nations Development Programme (UNDP) and special thanks must go to these organisations for their financial and technical assistance to prepare National Reports and regional input to UNCED.

The National Reports to UNCED, were compiled local counterparts and consultants under the guidance of National Task Forces which included government officials, consultants and non-government organisations. This process, involving the key interest groups, is extremely important to the sustainable development of island environments. Countries, with the assistance of SPREP, are continuing this process and building upon their input to UNCED by drafting National Environment Management Strategies (NEMS). Also supported by ADB and UNDP, these NEMS contain the national priorities that will guide the implementation of Agenda 21 and other UNCED outcomes. I hope that this effort will stimulate an appreciation of the concerns and aspirations of this unique region and encourage all to work with us in making sustainable development a reality in the Pacific.

Vili A Fuavao
Director, SPREP

ACKNOWLEDGEMENT

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UNITED NATIONS CONFERENCE ON ENVIRONMENT
AND DEVELOPMENT

FIJI NATIONAL REPORT

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A. EXECUTIVE SUMMARY

1. Development trends and environmental impacts

Fiji is an archipelagic nation consisting of more than 300 islands scattered over 1.3 million km of the South Pacific Ocean. The two large, mountainous islands of Viti Levu, where the bulk of the population resides, and Vanua Levu comprise 87% of the total land area. The islands are characterised by diverse ecosystems, including significant areas of natural forest. A wide range of coastal and marine ecosystems occur, ranging from extensive areas of mangroves to various coral formations.

The islands have a rich cultural heritage extending over at least 3,000 years. The ancestral Fijians had a significant impact on the environment, most notably the conversion of forests on the drier leeward sides of the main islands to fire climax grasslands. It is known that they also practiced traditional resource conservation measures.

Utilisation of natural resources on an industrial basis commenced with the advent of Europeans in the earlier 19th century. Following Cession to Britain in 1874 plantation sugar cane production was developed as a major industry. A social consequence associated with this development was a change in the ethnic composition of the population with the importation of indentured labour from India, practiced from 1879 to 1916. However, 83% of the land in Fiji remains under traditional ownership.

Reliance on natural resource exploitation continues to support the national economy both directly, through agricultural production, forestry and fisheries and indirectly through tourism.

At the moment Fiji is relatively well off with low overall population pressures and, compared to other Pacific islands, a rich resource base. However, the warning signs of environmental, and quality of life, deterioration are present and Fiji needs to carefully assess its position regarding over-exploitation of resources or sustainable utilisation.

Natural Resource Endowment

Fiji has a mild tropical maritime climate with plentiful rain under prevailing conditions. However, it is subject to potentially catastrophic climatic events such as cyclones, flooding and drought which can have a major impact on the economy and infrastructure. The predicted climate change and sea level rise could have profound consequences for agriculture and coastal development.

The geology is highly mineraliferous, with at least one economic operating gold mine and the prospect of further mineral development, including copper and gold. The mountainous terrain limits the area of land available for extensive development to coastal areas, and is subject to earthquakes and landslides. The larger islands have limited (19% of land area) arable soils capable of supporting intensive agriculture, with a further 10.5% capable of being productive with only minor improvements. However, nearly 70% requires either intensive land management or is unsuitable for use.

On the larger islands, a relative abundance of annual rainfall, perennial rivers, good surface drainage and numerous springs ensure that there is no fundamental problem in obtaining domestic water supplies. However, the frequent turbidity of many of the larger rivers, seasonal shortages of rainfall in the dry zones of Viti Levu and Vanua Levu and a lack of extensive water reticulation results in local scarcity of supply during some dry seasons.

On the low-lying, smaller and outer islands where there are no perennial streams, freshwater is a much scarcer resource. Generally water is extracted from wells or collected in private or communal tanks. In such situations shortages are of common occurrence not so much as a result of lack of rainfall overall but because of deficiencies in water collection. The Government is then frequently called on to provide water at great expense.

Fiji has a rich vegetation and wildlife. The floristic diversity of the forests has not been adequately documented but it is in excess of 100 species per square kilometre. Most of the interior forested areas have been scarcely collected. The tropical moist forest has a high level of endemism (uniqueness) and genetic importance. Some ecosystems such as the Beach Forest have virtually disappeared through clearing. The area of remaining indigenous forest is estimated to be 750,000 ha. Both vegetation and wildlife have great scientific, heritage and potentially tourism values.

The coastal zone is of vital importance to Fiji's society and its national development. It brings together a unique assemblage of resources such as reefs, mangroves, water, agriculture, seafood and high quality landscapes. Yet it is also the location of every significant town in Fiji, most villages and the vast majority of the population together with industry and commerce. The current estimate of mangrove forest is that approximately 42,000 ha remain of an original resource of about 45,000. Types of coral reefs include fringing and platform reefs and two of barrier reefs. Other unique features, such as anchialine pools, also occur. Marine and coastal ecosystems support both subsistence and a growing commercial fisheries sector.

Patterns of Economic Development

The Interim Government has implemented a shift in direction from the previous methods of national economic development planning which relied on five year development plans. The Government has taken the path of deregulation of the economy with an emphasis on an export-led growth strategy and economic diversification to achieve improved standards of living.

The Fiji economy is heavily dependent upon international trade and finance. Natural resource based production accounted for almost 60% of domestic exports in 1990. Imports are comprised dominately of food, energy, manufactured goods and chemicals. Importation of automotive fuels are high. Development assistance only represents about 3% of gross domestic product. Income distribution in the community is uneven, with an acknowledged level of poverty.

Although there has been a significant change of direction in national economic policy the fundamental basis of national development, from an environmental perspective, remains the same. That is, significant elements of the national economy (agriculture, tourism, forestry and fisheries) depend on exploitation of the natural resource base. This implies that planning for economic development cannot ignore the need to conserve and manage those resources in a sustainable manner.

Population and Demography

In 1874, the year of Cession, the Fijian population was about 135,000 and declining as a result of devastating diseases which came with European contact. The Fijian population continued to decline until 1921, when it reached 84,475 in a population totalling 157,266 which by then also included 60,634 Indians. The Indian component increased to 49% of the population by the 1986 census, with Fijians at 46%. Significant migrations by Indians following the political upheavals of 1987 reversed this trend, with the current population composition estimated to be Fijians 49.6% and Indians 46.1% in a population of 737,200. The population growth rate is modest.

Over 60% of the population resides in rural areas, but urban drift is apparent. Population densities were 39.1 persons per km in 1986, this is expected to increase to 45 persons by 2001. However, if densities are calculated per km of arable land, population pressure on land resources would appear to be accentuated at densities in excess of 170 per km. With the almost complete utilisation of first class arable land, the current expansion of agriculture into marginal hill areas and steep lands will continue and increase. Therefore, even small increases can begin to dramatically expand localised land degradation.

Natural Resource Use and Environmental Issues

Almost 39% of the population live in urban areas and the proportion and growth rate are both increasing. Forecasts indicate that during the coming 15 years, the urban housing stock will have to increase by nearly 19,000 houses in order to accommodate even a modest population growth. This will place increasing pressure on services and infrastructure. Residential subdivisions in the past have frequently been poorly planned and controlled. Negative changes are also occurring with the loss of heritage buildings and attractive urban landscapes.

One of the advantages of Fiji's position as an isolated island nation is the absence of many of the world's serious diseases. Two major ones of concern, both mosquito born, are dengue fever and filariasis. Major developments such as irrigation projects and agriculture, and poor rubbish disposal provide breeding grounds for disease vectors.

The drive for increased agricultural production has led, in the past, to extensive reclamation of mangroves. The practice has proven to be economically unviable and resulted in considerable national financial losses. Some agricultural practices, such as steepland sugar cane and ginger production, increase natural erosion rates, which are already high. This results in loss of topsoil and sedimentation of rivers and streams. The siltation has led to the expenditure of millions of dollars in river dredging. The lack of security of tenure to non-Fijian farmers who must lease land from traditional owners does not encourage careful husbandry of limited soil and water resources.

Deforestation in Fiji is moderate but continuing. Since 1967 an estimated 90-140,000 ha (11-16%) of the nation's forests have been converted to non-forest land use. These figures are not so severe as to cause immediate concern about the disappearance of the forests of Fiji. However, there is a severe imbalance in the distribution of forest with the drier parts of the larger islands and many of the smaller islands having suffered severe deforestation. Fiji has embarked on some highly successful plantation establishment programmes. The softwood (pine) plantations total over 43,000 ha and are established primarily in the dry zones, as reforestation of degraded lands. In contrast, the hardwoods, principally introduced mahogany have been established within existing native forests, with potentially adverse environmental implications. Current logging practices cause a great deal of avoidable environmental damage. The adoption of a National Code of Logging Practice is a welcome move, but it is only as good as its enforcement.

The only significant long-term fisheries development prospects for Fiji (in terms of volume) are likely to be in the offshore areas, particularly pelagic. Aquaculture development, both

freshwater and marine, has and is being attempted with varying success. Attention needs to be focussed on the legislative and environmental impact aspects of aquaculture to mitigate the kind of problems which arise from extensive fish farming in more developed countries, such as water usage, polluted return water and appropriate land use. Traditional fishing right owners can be a potent force for fisheries conservation, since the owners of each qoliqoli presumably have a paramount interest in protecting the resource for their own future benefit. But increasingly, owners of qoliqoli are becoming involved in business and, in certain cases, consider the qoliqoli simply a source of disposable income.

In most areas freshwater is not regarded by the public as a scarce resource and waste is commonplace. Even in areas subject to frequent shortages, water conservation is sometimes lacking. Supply and quality of water to urban centres is generally satisfactory, although Ba town is an exception due to poor watershed management. Supply and quality in rural areas is less satisfactory.

Tourism was Fiji's biggest foreign exchange earner in 1990 and is therefore a major contributor to the national economy. Although responsible for avoidable environmental impacts tourism offers considerable opportunities for sustainable development through enhanced linkages with the environment. Developing landowner tourism ventures based on 'non-standard' tourism resources are encouraging indicators of the potential that exists.

Mining, both existing and potential, offers major economic benefits. However, it needs to be carefully planned, evaluated and monitored if the harsh environmental and social lessons of other countries, notably Papua-New Guinea in this region, are to be avoided.

Fiji has benefitted greatly from the commissioning of the hydro-electricity from Monosavu Dam. Industrial diesel oil imports dropped by two thirds, saving \$20 million in 1984. The country makes relatively good use of biomass energy. The largest producers of waste, the Fiji Sugar Corporation and Tropik Woods, both use waste to produce power. However, in other areas waste accumulates and disposal methods leave much to be desired. Fiji also has responsibilities to reduce emissions of 'greenhouse gases'.

The push for a larger manufacturing sector will further encourage expansion of urban populations. It is unlikely that 'high pollution risk' industries will be greatly attracted to Fiji. However, the diversity of industry will expand, further taxing currently inadequate pollution controls. New industries will require new industrial complexes and the current steady erosion of prime agricultural land to other uses may be accelerated. Alternately there may be calls for further reclamation of mangroves and coastal areas.

Industrial activities in Fiji are varied and quite robust for a small country in an isolated location. Because of the absence of direct regulations controlling water or air pollution and the consequent lack of monitoring, there is a serious lack of data on the types and extent of pollution present, particularly industrial pollution. Refuse disposal and management of garbage dumps is a national dilemma which requires a firm Government initiative. Littering is a major problem which cannot be solved by legislation alone - public education is essential.

2. RESPONSES TO DEVELOPMENT/ENVIRONMENT ISSUES

Environmental Policy in National Development and International Relations

Environmental policies and objectives, to a lesser or greater extent, have been presented in national development plans since 1971. However, their implementation through practice and resource/funding allocation has been minimal. Unfortunately, environmental concerns have been effectively sectoralised rather than becoming an 'across the board' approach throughout Government.

The Government has become party to a number of international conventions and treaties. In the last two years it has acceded to or ratified several significant conventions which place increased responsibilities on the Government at national and international levels with regard to environmental issues. The Government is also participating actively in international discussions on such issues as climate change.

Environmental Laws and Administration

Fiji's environmental laws are many and varied, a relic of the colonial period when environmental problems were limited and clearly sectoral. At least 25 Acts have some important role in what is today perceived as environmental management, and they are ministered by at least 14 different ministries, statutory bodies or other agencies. Most of the laws are old and ineffective in a modern environmental management context or suffer from lack of enforcement of regulations through inadequate staffing, lack of technical resources and funding, or through administrative failures.

Development of a specific environmental planning function has taken place within the Department of Town and Country Planning. An interministerial Environmental Management Committee has been operating since 1980. However, a 'higher level' Governmental coordinating body is now required to control the numerous ad hoc environment related activities taking place. Since 1989 a small, under-resourced Environment Unit with one professional specialist has been operating in the Department.

Values and Attributes

Fiji has achieved a high level of education provision. However, environment education is not included in school curricula as a formal subject. Currently environmental awareness and concern in all communities in Fiji is at a very low level. Effective environmental control and management will require further direction and resources and will only be obtained if there is a rise in the level of community awareness.

Protected Areas and National Parks

Although neighbouring Pacific nations have internationally recognised national parks, Fiji has none. The reason for this lack of national parks or equivalent areas is not due to a lack of sites - the country has outstanding potential. The only designated national park, Sigoka Sand Dunes, has no form of effective management and therefore does not qualify under the international definition of a national park. Unless a system of national parks is set up quickly valuable aspects of Fijian heritage, both natural and cultural, will be lost.

3. PLANNING FOR SUSTAINABLE DEVELOPMENT

State of the Environment

Fiji has many positive physical and cultural attributes which it can draw upon on a sustainable basis for its ongoing development. It also has significant environmental constraints which are currently compounded by inadequate environmental management legislation and administration.

Fiji lacks the serious demographic, economic and industrial pressures from which the majority of serious environmental problems originate. But conversely, its small size, young landscape and evolutionary isolation make its environmental resource vulnerable to loss or degradation. In addition, the vast majority of the population, industry, important infrastructure and economic activity is located in the coastal zone, which is an ecologically complex area highly susceptible to both natural hazards and human violation. This zone will receive the major impacts of global warming.

Fijian landownership and customary rights and their future management are central to sustainable development and sound environmental management. Two approaches need to be undertaken: preparation of a national land use plan derived through both technical land-capability assessment and consensus based on full community participation; and a major effort to provide a special form of community education required to give traditional community decision makers the technical and other knowledge they would need to manage the environment and resources in a modern development context.

National Environment Management Project

It is considered premature to make specific recommendations on environmental management and sustainable development within the context of this National Report for UNCED. Government's response to the acknowledged need to develop a strategy for long term sustainable development has been to approve the preparation of a National Environment Strategy through the National Environment Management Project. This project commenced in August 1990 and will be completed in August 1992. A decision has been made not to pre-empt the outcome of this project.

B. DEVELOPMENT TRENDS AND ENVIRONMENTAL IMPACTS

Fiji is an archipelagic nation consisting of more than 300 islands spread over 1.3 million km² of the South Pacific Ocean, extending 10 - 25 South latitude and between 176 East - 173 West longitude (see map). The total land area of 18,333 km² is composed of large mountainous islands, such as Viti Levu and Vanua Levu (which take up 87% of the total land area) which are of volcanic origin, and numerous small volcanic islands, low lying atolls and elevated reefs. The largest islands have a diverse range of terrestrial ecosystems, including extensive remaining areas of indigenous forest. The high islands have distinct wet and dry sides due to prevailing wind patterns. Coastal ecosystems include mangroves, algae and sea grass beds in shallow reef and lagoon areas, and various reef types such as barrier, fringing platform and atoll reefs.

The ancestors of the modern Fijian people entered this rich, diverse environment at least 3,000 years ago. These people developed a neolithic, shifting cultivation, hunting and food gathering society based on a complex hierarchial, extended family system more in common with other Polynesian societies in the Pacific than with the Melanesian societies of the west. Their arrival undoubtedly heralded some extensive and some intensive changes to Fiji's original ecosystems. The most widespread change attributed to the ancestral Fijian people was the conversion of large areas of forest on the drier sides of the main islands to savannah grasslands through the use of fire. Archaeological evidence also indicates that many birds became extinct following the arrival of the first settlers. Nevertheless, it is known that the Fijians practiced traditional conservation measures in agriculture and hunter/gathering in an attempt to maintain sustainable use of their natural resources. Inter-island and regional trade networks were developed to exchange various resource commodities, such as crafted artifacts, shells and parrot feathers. The predominance of natural resource products in trade still remains a characteristic of modern Fiji.

The advent of Europeans into Fiji in the early nineteenth century could be regarded as the beginning of Fiji's entry into the international commercial trade system with the first large scale exploitation of its natural resources. This exploitation commenced with sandlewood cutting and beche-de-mer harvesting on an itinerant basis and then into the development of permanent plantation agriculture, primarily of copra. Following the cession of Fiji to Britain in 1871, the development of the country intensified under the colonial administration. The most significant development feature of the late 1800s was the introduction of sugar cane production. The sugar cane industry, utilising a significant proportion of Fiji's arable soils, developed into the most important sector of the Fiji economy, only being surpassed in terms of gross revenue earnings by tourism in 1990. The development of large scale commercial agriculture has had a marked effect on the

islands of Viti Levu, Vanua Levu and to a lesser extent, Taveuni. The concentration of plantation agriculture on the flatter coastal lands has resulted in the virtual loss of lowland and primary beach forest on these islands. Currently, with attempts to increase production and also as a consequence of an increasing rural population, sugar cane production is occurring on agriculturally marginal land on steeper slopes. This is already creating problems with soil erosion and subsequent sedimentation of streams and rivers.

A social consequence of the introduction of plantation sugar cane production by the colonial government was a change in the ethnic structure of the country's population. This was a result of the importation of indentured labour from India to work the cane fields. Following the cessation of the indentured labour system in the early 1900s many of the Indian workers elected to stay, eventually resulting in the evolution of a large Indian component of the population (currently 46% of the population).

The economic reliance on natural resource exploitation has continued to the present time, with development of other agricultural products for both internal consumption and export. Both sugar cane and rice have been established on reclaimed coastal areas, resulting in loss of mangroves, including in some cases, the sterilisation of productive mangrove systems as well as the inability to grow target crops due to high soil salinity. Ginger production is carried out on steep slopes, generally in a manner which erodes, rather than conserves, the soil. The forestry and fishery sectors have also been targetted for expanded development, highlighting the need for careful management of forest and marine resources.

The manufacturing sector, although small, is receiving incentives from Government, in the form of land and tax concessions, to expand and develop. Existing industrial development established over the last 20 years has already generated environmental problems and issues in relation to such aspects as mangrove destruction and pollution. Further expansion of this sector needs to be carefully controlled. Similarly with the mining sector which is currently limited to gold production at Vatukoula. Further gold development is likely on Vanua Levu and of major significance from an environmental perspective, a large low grade copper deposit is currently under exploration.

The tourism sector has risen to the forefront of the national economy in the last two years, following its establishment in the mid-1960s. Although creating its own environmental and social problems it does, overall, offer the potential for a very effective amalgamation of national economic and environmental objectives.

Fiji contains a number of major cities and towns which have been established historically as administrative, commercial, industrial, service and port centres throughout the country. Although over 60% of the population live in rural areas there is a trend of urban migration. This is placing pressure on urban infrastructure (housing, water, sanitation) to cope with the increasing demand. In environmental terms this is resulting in: effluent and solid waste disposal problems; increasing pressure on peri-urban marginal agricultural land to supply urban needs and to provide income through sale of products for people in low socio-economic groups; loss of mangroves through clearing for squatter settlements, and subsequent demand for building materials and firewood; and a gradual decline in the quality of the urban landscape as more naturally vegetated and park areas are taken over by subsistence and entrepreneurial vegetable growers. The large number of poorly maintained buses and taxis, the 'common man's' transport, as well as an increasing number of private vehicles is resulting in significant air pollution from vehicle emissions, further decreasing the quality of life in urban environments.

These and other issues are explored in detail in the following chapters. In considering the overview, it is clear that Fiji's evolution into a relatively 'well off' developing country has been based on the exploitation of its natural resource endowment. Despite the Government's current emphasis on economic diversification Fiji will continue to be dependent on the major primary industrial activities of sugar production, forestry and fisheries, and on tourism to support its economic and social development. All of these require careful management and conservation of the natural resource base which supports them.

As Fiji approaches the end of the present century the balance of development and environmental quality is not outweighed on either side of the scale. National economic development has on the one hand, been responsible for Fiji's progression to the leading island nation of the South Pacific while, on the other, it still retains much of its natural resource endowment, and environmental and cultural heritage. However, the warning signs are clearly evident and the nation needs to take careful stock of its current development and environmental status. Fiji is, in many ways, standing at a crossroads where commitment to one path may lead to ongoing exploitation and depletion of non-renewable resources, which in turn will lead to depriving future generations of their resource inheritance and a lowering of their standard of living. Alternatively, the country can develop a sound environmental management framework for sustainable development and use of its natural resources and, hopefully, continue to maintain an equitable balance between development, environmental quality and social health.

1 NATURAL RESOURCE ENDOWMENT

1.1 CLIMATE

Winds

At all seasons the predominant winds over Fiji are the trade winds from the east or southeast. On the western and northern sides of Viti Levu and Vanua Levu, however, day-time sea breezes blow in across the coasts with great regularity. In general the winds over Fiji are light or moderate, the most persistent being in the period July - December; strong winds are uncommon, with the exceptional cyclones which generally occur in the period of November - April.

Temperatures

Temperatures at lower altitudes around Fiji are usually fairly uniform. In the lee of the mountains, however, on the western and northern sides of the main islands (Viti Levu, Vanua Levu and Taveuni) the day-time temperatures often rise 1-2°C above those on the windward sides or on the smaller islands. At the same time the humidity on the lee side tends to be somewhat lower.

Because of the influence of the surrounding oceans the changes of temperature from day to day and season to season are relatively small. Average temperatures change only about 3-4°C between the coldest part of the year (July-August) and the warmest (January-February). However, the higher humidities in the warmer season (December to March) make conditions noticeably less comfortable then.

Rainfall

Rainfall is highly variable but generally the average rainfall increases steadily inland from coastal areas. It is usually plentiful between December-April, especially over the larger islands, but in May-October it is often deficient, particularly in the 'dry zone' on the western and northern sides of the main islands (see Figure 1).

In the drier period the heaviest rainfall occurs on the windward (southeast) sides of the mountainous islands. On Viti Levu, places in the Nausori-Suva-Pacific Harbour area have rain on five or six days out of 10, amounting on the average to between 1000 mm and 2000 mm for the season. At the same time the western and northern sides are sheltered by the mountains, experience much sunny weather, and often suffer drought. Places like Nadi, Lautoka, Ba, Rakiraki and Labasa have rain on only about two days out of 10 and average on about 300 mm to 500 mm of rain for the half year. The smaller islands usually receive amounts between those on the wet and dry sides of the larger islands.

All parts of Fiji normally get more rain in the warm season. In the wetter half year (November to April) places on the wet side of Viti Levu, in the Nausori-Suva-Pacific Harbour area, have rain on seven or eight days out of 10, and the seasonal rainfall averages some 1800 mm to 2600 mm.

The seasonal increase in rainfall is more spectacular in the 'dry zone'. The half-year totals average 1300 to 1600 mm - much higher than in the 'dry' season but still not as great as on the 'wet' side.

Because of the great variability of rainfall in the region, averages have little value as indicators of what the rainfall is likely to be in any particular month or season.

Climatic extremes

Atmospheric disasters are related to climatic extremes and in Fiji high winds and storm surge are the most significant of these. Occurrence of damaging waves is also of significance and may occur without a tropical cyclone.

Flooding is regarded as a hydrological event which may be aggravated by storm surge. Flash floods that affect coastal regions are likely to occur at about the same time as high winds and surge, resulting in particularly dangerous and damaging conditions.

Cyclones

Fiji lies in the area occasionally traversed by tropical cyclones. They are mostly confined to the period November to April, with greatest frequencies around January and February.

About 10-15 cyclones per decade directly affect Fiji (52 have crossed Fiji in the last 42 years). Some of these would have produced only marginal gales (sustained winds of 34-40 knots) in some part of the Fiji Group. On the average about two to four cyclones per decade cause severe damage.

In most parts of Fiji individual localities experience the nearby passage of a tropical cyclone (within 70 km) some two or three times per decade. Not all will have destructive intensity at the time they pass. Individual localities are likely to be exposed to moderate or severe damage about once in one to two decades.

Approximately 66% of cyclones striking Fiji do so from the northwest quadrant and most of the remainder do so from the northeast quadrant. They tend to reach peak intensity towards the south rather than the north of Fiji.

The Yasawas, west Viti Levu, Kadavu and northwest Vanua Levu, Cikobia and the Lau Group are more affected than other areas in Fiji.

Storm surge

Storm surge is an effect which accompanies most cyclones in Fiji. Table 1 summarises the available information on the occurrence of surge in past cyclones since 1972. Historical data on storm surge in Fiji is not very reliable. The extreme experienced during the last two decades is of the order of three to four metres.

Consequences of Fiji's climate

Climate has environmental consequences which are normally overlooked. It controls the type and luxuriance of vegetation, the potential for commercial crops and livestock, but its overriding effect is on the population as a whole. It dictates man's diet, clothing and to a large degree habits. Culture and character are influenced, as well as energy and efficiency. Fiji's generally benign climate punctuated by severe, levelling cyclones, and other disasters has played a major role in the shaping of the cultural values and attitudes of the indigenous Fijians. Development based on highly capitalised infrastructure whether in the public or private sectors will always be subject to climate induced setbacks.

Climatic influences on landform and agricultural potential can be profound. From an erosion perspective the most important climatic factors are the wind and rainfall. The most important feature of the rainfall, however, is the intensity. Data on rainfall intensity are very limited and calculation of 'intensity values' is possible for only a few locations. The limited information tends to indicate that 'intensity values' are high (greater than 500/yr) for the whole of Fiji.

Further evidence of the rainfall intensity is given in Table 2 with the data for maximum monthly rainfall and maximum rainfall in one day. For example, 1068 mm in one month at Labasa, 347 mm in one day in Suva. Maximum daily rainfall frequently occurs when cyclones or tropical storms pass through the islands. When such storms occur, river flows increase dramatically and sediment transport is visibly enhanced.

Extremes of weather cause disaster. The magnitude of most disasters depends not on the severity of the extreme event alone but to as large an extent on the socio-economic condition of the community and the extent to which severe events are anticipated and taken account of in physical, regional and national planning. Wise planning adopts a far-sighted preventive approach to atmospheric and other hazards

rather than relying on event by event, economically costly, fire-fighting mode of disaster management.

Such measures as risk-zoning based on hazard risk assessments and disaster vulnerability assessments, proper land-use planning, sensible watershed management, appropriate legislation and regulatory instruments can help avoid disaster and serious economic setbacks.

Global warming - implications for Fiji

Fact or fiction ?

Global warming and the associated issues of sea-level rise and the greenhouse effect are topical subjects worldwide at present. There is much conjecture, some alarming predictions and then provocative counter claims, but to the layman nothing much has changed. Such topics cannot be maintained in the public arena for long without substantial reinforcement, and consequently it appears to be increasingly fashionable to be dismissive of the issue.

This is folly. Global warming is an established fact, as is sea-level rise. In general terms the implications for Fiji and South Pacific countries are now quite well known. What is still conjectural is the magnitude and rate of increase.

There is evidence for global warming in Fiji itself, the average temperature at Government House has been statistically proven to have increased by over half a degree ($^{\circ}\text{F}$) in the last century. While high altitude temperatures over Fiji have increased by 0.7°C in the last 35 years.

South Pacific sea surface temperatures have risen also, by $0.5-1.0^{\circ}\text{C}$ since 1912.

It is generally assumed that the current global warming is a result of rapid industrialisation over the past 300 years in the northern hemisphere and the resultant increase in the atmospheric concentration of greenhouse gases. But only rarely is the comment made that climate changes have occurred regularly in the history of the Earth. However, the current man-induced changes are occurring at a much faster rate than the natural climatic changes of the past.

A likely scenario

Even if emissions of greenhouse gases were stopped immediately, the warming trend would continue for decades and probably increase in rate. Fiji has absolutely no control of this as its emissions of greenhouse gases are negligible by world standards. The widely accepted view by scientists is that the sea-level will rise 1 m by 2100.

Implications for the future

The implications for Fiji of a substantial sea level rise and increase in temperature are very varied and extend far beyond the physical effects on the coastline. However it is the coastal zone which will experience the greatest changes and since well over two thirds of Fiji's population live in the coastal zone, the majority of the population will be directly affected. There are likely to be major changes in weather patterns too and these will extend the overall effects further inland. In consequence the whole nation will be effected.

A recent United Nations report concluded that for Fiji the implications were:

Moderate to severe impacts will occur, locally devastating. Major changes to crop production systems, demographic patterns and social infrastructures.

The major impacts of a general nature to be expected are presented in Table 3.

1.2 LANDFORM AND SOILS

Geology

Fiji's 300+ islands form part of a complex arc structure of volcanics, volcanic-derived sediments and reef deposits dating from the early Cenozoic (40-50 million years ago) to the present. This structure is located in a complex convergence plate boundary zone between the Australian and Pacific plates. In addition to a record of volcanic, sedimentary and reef rocks, uplift and erosion have exposed plutonic and low-grade regional metamorphic rocks belonging to the older part of the record.

A single mine, the Emperor Gold Mine operates in Fiji at present. There are other prospects in various stages of exploration or feasibility study including a large copper deposit in Namosi, the former gold mine at Mount Kasi, Vanua Levu and the marble deposits of Naqalimare and Wainivesi.

The Fiji Group lies in one of the seismically most active areas of the world. Earthquakes have been recorded in the area from 1850 to the present day and are the major geological hazard in Fiji (see Figure 2).

Several major earthquakes have been recorded in the Fiji Group. The most significant were those in Kadavu (1850), Suva (1953) and Taveuni (1979), with another eight having been recorded between 1850 and the present day. The 1953 Suva earthquake was the most destructive in Fiji's recorded history. The accompanying landslides and tsunami caused considerable damage in the Suva, Nausori and Navua areas.

An analysis of the earthquakes recorded in Fiji to date indicate fluctuations between periods of relatively low seismic activity and active periods. Although estimates are based on limited information it appears that active periods last around 10 years, and are followed by quiet periods of 20 years.

Recent studies suggest that a large earthquake of magnitude 7.0 (Richter scale) is likely to occur in Fiji every 30-35 years.

The northeast zone is the most active and the largest earthquakes have taken place there (Taveuni, Rabi and eastern Vanua Levu).

The northern zone, including northern Vanua Levu and the Yasawas is the second most active. Large quakes in this zone are also frequently felt in Nadi, Lautoka and Ba and occasionally in Suva.

Southeastern Viti Levu has recorded scattered minor earthquakes since the seismograph network centred in Suva was established in 1979. Navua, Suva and Ovalau are often shaken by minor tremors. Large earthquakes were recorded in the zone in 1869 and 1953. Rotuma is not in a recognised earthquake zone.

Although tsunamis are widely known as tidal waves they have nothing to do with tides. They are sea waves of very long period and low height, they may follow a large earthquake under the sea and may also be caused by fault movement, lumping or uplift of the sea-bed. Occasionally, they may also result from earthquakes where the shock is centred on land.

Eleven tsunamis have been recorded in the Fiji area since 1877. Of these, two had their source in Chile and the remainder between Vanuatu and Tonga. Only three produced waves of significant height, notably 2.0m in 1877, 1.8m in 1881 and 1.8m (Suva) and 4.6m (Nakasaleka, Kadavu) in 1953. The other eight were all less than 0.5m wave height.

The reef system protects most of Fiji from local and distant tsunamis and only the 1953 tsunamis are known to have caused damage and loss of life. However, with an anticipated rise in sea-level and the possibility of a tsunami at high tide, the amount of protection offered by the reef system may diminish.

During the 1953 Suva earthquake, a tsunami of 1.8m height, reached the Suva shore, but this occurred at low tide. If the wave had occurred at high tide, it has been estimated that the wave could have been at least 2.8m high and could have had a disastrous effect. Nakaseleka is not protected by a reef and the tsunami that reached the shore was 4.6m high.

Although there have only been three major tsunamis affecting Fiji in the last 110 years, and only one of them in the last 106 years, there is a possibility of a major tsunami being generated by any major local earthquake.

Topography

Physical relief is an important environmental factor for it largely determines soil resources, the conditions under which people live and work and hence their occupations.

Fiji's larger volcanic islands are dominated by steep, mountainous country deeply incised by rivers and streams. The highest summit, Tomaniivi, is 1,323m and there are 30 peaks over 1,000m. On the four major islands, 67% of Viti Levu, 72% of Vanua Levu, 49% of Taveuni and 78% of Kadavu is steep land (slopes greater than 18°). Thus much of the surface runoff following heavy rain will be over steep slopes with the eroding capacity of the water being markedly increased.

In Fiji's geologically young landscape, landslides are a relatively common natural event and are the major contributors to the high sediment loads in the larger rivers. Unwise agricultural practices, road building, logging, mining, etc., can greatly increase the hazard if the landslip-prone characteristics of the terrain are not respected.

Prolonged torrential rainfall, not necessarily but usually associated with cyclones can cause multiple landslides in highly localised areas. These occur irrespective of land use in such sites. In the past 15 years there have been three such events - in the Korovisilou area in April 1980 during cyclone Wally; in the Mt. Koroba, west Viti Levu area during cyclone Oscar in 1983 and during April 1986 in the upper Waimanu area, an event which was not associated with a cyclone. This single storm initiated 620 landslides representing 570,000m³ of soil, or 90 tonnes/ha over the catchment as a whole.

Soils

The general pattern of soils is best described by separating the soils into three topographic groups and superimposing on this a subdivision based on altitude and climate.

The topographic separation shows:

- . soils developed on the relatively flat areas derived from river or marine deposition - approximately 15% of the land surface;
- . soils developed on rolling to hilly land - approximately 20% of the land surface; and
- . soils developed on steep slopes of hills and mountains - approximately 65% of the land surface.

Fiji's soils can be grouped genetically as follows:

- . Young sandy soils formed around the coasts of the island.
- . Fertile, deep, agriculturally important alluvial soils occupying the valley bottoms.
- . Shallow and moderately deep, dark coloured, nutrient rich soils on rolling and hilly land.
- . Sandy and silty moderately deep to deep soils formed from volcanic materials (including ash) containing particles of unweathered parent material within the solum.
- . Deep, highly weathered clay-rich soils, often acid and of low base status derived from basic parent materials.
- . Deep, highly weathered oxide-rich clay soils of limited agricultural value.
- . Deep sandy soils derived from acid parent materials having clay increases in the subsoils, usually strongly weathered and of low base status.
- . Gleys and peats occupying low-lying areas in valleys or on plateaux.

Erodibility of a soil is a complex property dependent both on its infiltration capacity and on its capacity to resist detachment and transport by rainfall and runoff and is therefore dependent on properties such as particle size distribution, organic matter content, presence of structure cementing agents, bulk density and filled pore space. Erodibility is expected to be low for most Fiji soils because 66% of the country's soils generally have moderately to well developed surface soil structure, and are moderately-well to well drained.

Land use capability

To the casual observer, a flight over Viti Levu or Vanua Levu would reveal large areas of forested apparently unused land, and to many this gives an impression that Fiji has tremendous potential for agricultural expansion.

Nothing could be further from the truth, in fact Fiji's prime agricultural land is already being almost fully utilised. Henceforth, any agricultural expansion will be in marginal areas which will require conscientious management if it is to be utilised sustainably.

Fiji's most comprehensive land-use capability survey revealed the following:

- . only 19.4% of Fiji's land, covering some 355,750 ha can be considered first class land for sustained arable agriculture;
- . a further 10.5% or 193,195 ha is second class land requiring only 'fairly minor improvements for good agricultural use';
- . 31.9% or 586,752 ha of Fiji's land requires a great deal of land management if it is to be used for sustainable agriculture; and
- . the largest category of all, estimated to cover 702,092 ha or 38.2% of Fiji's total land area, is quite unsuitable for agricultural development but may be of limited use for production forestry.

Based on this land and capability survey, two land use assessments have been reported (Table 4).

Agriculture

While over 60% of the total land area is suited to some form of agricultural activity only about 16% is suitable for sustained arable farming. The area of land in use has increased by more than 200% over the past 30 years, partly due to marginal land being brought into arable usage. During the same period there has been a small but steady loss of good arable land to non-agricultural uses. There are now basically no extensive areas of unused agricultural land and the major drive is currently to increase productivity.

Agriculture remains the single largest sector of the Fiji economy accounting for some 20% of the Gross Domestic Product and 80% of employment.

Sugar is still the backbone of the agricultural economy with annual production now at 400-500,000 tonnes from approximately 4 million tonnes of cane grown on 95,000 ha. Copra production declined through the 1950's and 1960's but increased slightly in the 1970's. Some 56,000 ha are under coconuts producing about 19,000 tonnes copra/year. Ginger, primarily for export, is grown in hilly, erosion-prone land in the wet zone with 230 ha planted in 1990 producing about 5400 tonnes. Tropical fruits (passion-fruit, mangoes, pawpaws, pineapples and citrus) are being produced in increasing quantities but the total area in production is relatively small (less than 750 ha). A major expansion in cocoa production was planned for DP9 but the achievements in both planted area and yields have been poor. By 1990, 3970 ha of cocoa had been established by some 4,000 farmers. Much of the new planting (2255 ha in DP9) was in forested land which is thus destined for conversion.

Rice is produced on about 10,000 ha of land of which about 550 ha are under irrigation. Yields are generally average to low (2-3 tonnes/ha) but an intensive rice development programme is now underway expanding the area under irrigation fourfold, and increasing production such that total grain yield reached 45,000 tonnes by 1990. Maize production was 1950 tonnes in 1990 but major efforts are being made to expand production as some 10,000 tonnes of maize are imported annually.

Root crops (taro, cassava, yams) are produced in substantial quantities in all areas of the country, in both shifting cultivation and monoculture systems. Much is consumed at source but substantial quantities are transported to the major urban markets on Viti Levu.

Livestock production ensures self-sufficiency in pork and poultry, and 80% self-sufficiency in goat meat. Beef production is increasing slowly and is now at approximately 3,500 tonnes annually.

1.3 FRESHWATER RESOURCES

On the larger islands, a relative abundance of annual rainfall, perennial rivers, good surface drainage and numerous springs ensures that there is no fundamental problem in obtaining domestic water supplies. However, the frequent turbidity of many of the larger rivers, seasonal shortages of rainfall in the dry zones of Viti Levu and Vanua Levu and a lack of extensive water reticulation result in local scarcity of supply during some dry seasons.

On the low-lying, smaller and outer islands where there are no perennial streams, freshwater is a much scarcer resource. Generally water is extracted from wells or collected in private or communal tanks. In such situations shortages are of common occurrence not so much as a result of lack of rainfall overall but because of deficiencies in water collection. The Government is then frequently called on to provide water at great expense.

Rivers and lakes

Of all the islands, only Viti Levu has rivers of considerable size. The island is dominated by the Rewa River whose catchment covers nearly one third of the island. Two other major rivers, the Sigatoka and the Navua together with the Rewa and a few minor rivers drain over 70% of Viti Levu to the southern coast. In contrast two of Fiji's economically most important rivers, the Ba and Nadi have a combined catchment of only 15% of Viti Levu, all of which is in the dry zone.

The rivers of Vanua Levu are short, although the 55 km Dreketi River, is notable in being longer than the island's greatest width.

The only natural lakes in Fiji are small, the largest L. Tagimoucia on Taveuni being about 2 km.

Dams

Two major dams have been constructed in Fiji, both on Viti Levu. The smaller Vaturu Dam with a 2 km lake impoundment was specifically constructed to provide water for the dry western division of Viti Levu. Although much water reticulation infrastructure from the dam remains to be developed, the dam currently serves the major population centres of Nadi and Lautoka and is operating at less than 20% capacity.

The larger Monosavu Dam with a 6.7 km² impoundment provides hydroelectricity and has no water provision function.

A small dam has recently been built at on the Wainikavika Creek near Navua. The 0.8 km impoundment is shallow and is to provide water for rice irrigation.

Groundwater

Only recently has the groundwater resource been the subject of evaluation and development. The full extent of the resource is not yet known in most of the country and it will take many years of investigation before it is fully understood. A lot of knowledge has been gained of different aquifer types in specific areas (for example the Meigunyah aquifer in Nadi, the Ba fractured volcanics, the Labasa Basin, the gravel aquifers in the Sigatoka and Navua valleys). More development has been undertaken on islands with frequent water shortages, especially limestone islands. Some islands now rely heavily on groundwater supplies - Rotuma, Vanua Balavu, Lakeba, northern Taveuni. Tourist development in the Yasawas and Mamanucas has also relied to a large extent on groundwater resources.

Use of the resource

The sources used for water supply in the public, private and agricultural sectors are varied and dependent on such factors as the amount of rainfall, topography and population to be served. On the wetter sides of the three main islands, and on some of the higher outer islands, damming perennial streams and piping the water to the population centres is the main water supply system. Intake structures are usually small and storage for these schemes are provided by tanks. Larger population centres (Suva, Labasa, Sigatoka, Ba) are supplied from several sources such as catchment impoundment, river abstraction, and boreholes. These systems are installed at public expense, the supply is metered and the customer charged for usage.

Increasing urban populations and reticulation extensions are creating demands for additional water in many of the urban areas and supplementary supplies to existing schemes are now required to meet the new demand, for example Labasa, Navua and Ba.

On the drier side of Viti Levu, where river or stream flow is periodically insufficient the Vaturu Dam was constructed in early 1980s to provide a consistent supply for the Nadi-Lautoka urban areas and for tourism development. At Sigatoka, in the vicinity of the town, small streams are ephemeral while flow in the Sigatoka River is tidal and saline, so boreholes upstream in river gravels are used as the primary source.

Labasa previously only used surface water catchments, at a considerable distance from town as its supply source. The demand is now partially met by boreholes located closer to the town and the area of demand.

Where reliable streams do not occur within close distance of villages then alternative sources of water are sought. This situation occurs in the rural areas of northern and western Viti Levu and the outer islands. In northern and western Viti Levu many boreholes have been drilled for private use under the Government Borehole Subsidy Scheme to supplement or replace hand dug wells and rainwater tanks. Both these sources are frequently found to be inadequate during periods of extended drought. Similar sources are relied upon on the outer islands where little or no surface water is available, this is particularly so on limestone islands. Wells dug on coastal beach sand deposits are often brackish. Many villages have large communal rainwater tanks which collect water from the roofs of the local church and other large houses. During droughts these tanks are often found to be inadequate even when strict water rationing is imposed. Requests are then made for government barges to ship water from the main islands to replenish the village tanks. This is obviously an expensive exercise, since no charge is often made for the water as the exercise is treated as disaster relief. In western Viti Levu and Vanua Levu water is also carted by road tankers to supply villages and settlements whose normal water supply suffer from the effects of the droughts.

1.4 VEGETATION AND WILDLIFE

Flora and vegetation

A preliminary analysis of the Fijian flora has identified 476 indigenous Fijian genera of plants of which 10% are endemic or with other limited Pacific distributions. There are probably over 750 endemic species representing between 40-50% of the native vascular flora.

There is a single family (Degeneriaceae) endemic to Fiji and at least 11 endemic genera. As to be expected in an isolated island flora radiation and endemism in some groups is extreme. For instance the genus Psychotria (Family Rubiaceae) is represented by 76 species of which 72 are endemic. While there are 27 species of native palm, of which 26 are endemic including two at the generic level.

Ferns are well represented with over 310 species recorded.

Biodiversity and adequacy of the floral inventory

Fiji's flora is well researched in comparison with those of other South Pacific archipelagos but there are many localities, especially isolated forest areas which have never or scarcely been collected. New plant species are being regularly discovered, the most recent, in 1991, a new species of palm by S. Vodonivalu of the Pacific Regional Herbarium at the University of the South Pacific.

On the basis of the number known by only a single collection it seems probable that as many species may be unknown, possibly between 100-200.

The floristic diversity of Fijian forests has not been adequately documented but it is greatly in excess of a 100 species per km although it is likely that at least one thousand herbarium collections per 100 km are required to obtain a reasonable estimate of the floristic composition of an area. On this basis there are few if any areas in Fiji for which the species composition is adequately known. Most of the interior forested areas of Fiji, remote from roads, have been scarcely collected.

Genetic resources

By comparison with the Tropical Moist Forest (TMF) of other islands and continental areas of southeast Asia, Fiji's TMF is small in extent and relatively depauperate. It will, therefore, not be of major international interest for rain forest conservation, given the pressures being experienced elsewhere. However, its level of endemism is very high and the genetic resources of even its non-endemic species must be considered important as they are outliers, long isolated from their centre of distribution. They will thus have developed the genetic differences characteristic of outlier populations.

These can be of major significance even in the forestry sector where species 'provenances' (varieties) are central to many plantation breeding faculties.

Structure of Fiji's forest communities

The structure of Fiji's forests was once clearly distinguishable but today this is far less apparent with the almost complete loss of certain forest types, some of which were once extensive, and major human-induced disturbance to other forests.

Fiji's remaining forest is in the main a consequence of locality in being confined to areas of higher rainfall or at a greater altitude and in combination with steep topography.

Only remnant patches remain of the once extensive forests of the dry zone. These have been mostly converted to fire climax grassland or scrub communities. Only at higher elevations which receive more rainfall, within the dry zone, does forest cover remain. This distinctive forest type has been almost completely logged out.

A characteristic Beach Forest has been almost totally converted to agriculture/plantations, surviving only in isolated pockets on some of the smaller islands. The best forested islands are the limestone islands such as Kabara, Vatulele and Ogea, here the rugged karst terrain has protected fine stands of a special forest type.

Freshwater swamps

Fiji's freshwater swamps are very small in extent and restricted to areas of impeded drainage in some river valleys and parts of the coastal plains. One of the largest is the Melimeli Swamp between Suva and Navua, through which Queens Road traverses. In addition several of the volcanic craters in Taveuni support swamp vegetation. The total area of such swamps is reported to be only about eight km, but no full inventory has yet been undertaken.

Mangroves

Fiji has a considerable area of mangrove but the community is relatively simple by comparison with those of island and continental southeast Asia, there being only seven obligate species. These include the *Rhizophora* hybrid Selala, which is of great botanical interest and not found to any great extent outside Fiji. There are no endemic mangrove species and no terrestrial vertebrates are known to be confined to mangroves in Fiji.

Forest resource

The area of Fiji's indigenous forest and its subsequent management is based on a study undertaken during 1966 to 1969. The forests were classified on the basis of field surveys and aerial photographs. Three management classifications were adopted:

- . Non-commercial forests (unsuitable for timber production) in which 15 categories were distinguished.
- . Production Forests (suitable for timber production) in which 23 categories were distinguished.
- . Protection Forest (to be protected from soil erosion: unsuitable for timber production) in which different categories were distinguished.

However, the accuracy of the figures relating to indigenous forest is questionable since the Forestry Department has no applicable monitoring system. This is, in part, being rectified by a natural forest inventory currently being undertaken by the Fiji-German Forestry Project (Table 5).

In the meantime it would be more prudent to conclude that the area of the remaining indigenous forest is around 750,000 ha. Together with reforestation which has already brought some 50,000 ha of long deforested land back into production. Fiji thus has just under half of its total land area (1.83 million hectares) under forest. The impression that gives of a well forested country is, however, very deceptive. Broadly speaking extensive areas of the drier (mainly western) parts of the two larger islands and many of the smaller islands have suffered severe deforestation. Consequently the indigenous forest cover is actually very much more than 50% in the wetter parts of the country and very much less in the drier parts, while afforestation is mainly concentrated in the west.

Wildlife

A characteristic of oceanic islands is the limited wildlife and Fiji is no exception. It has no native terrestrial mammals with the exception of six species of bat. Birds are the most conspicuous form of wildlife and 60 indigenous breeding land birds survive, this number is approximately doubled when seabirds, migrants and introduced birds are included. Twenty four species of terrestrial reptile occur, two snakes, two iguanas, 10 geckos and 10 skinks. There are also two native species of frog. To these may be added the four species of sea snake and four species of marine turtle which occur in Fiji waters.

The level of endemism is high with 39% in the avifauna including two endemic genera (kula and the long-legged warbler), 35% in the reptiles and 100% in the amphibia. Of the mammals, one of the six species of bat, the Fiji flying fox is endemic (17%).

Endangered wildlife and plants

Fiji's flora is inadequately known, only a few species are known to be endangered, such as the well known vuleito palm, but it is strongly suspected that there are in fact many. For the flora, unlike the fauna, is peculiarly vulnerable to extinction of forms because of the very limited distribution of many species.

As one might expect the vast majority of endemic plants are forest species which do not survive in open habitats. Not all species are generally distributed, many have restricted ranges such that virtually every forested region of Fiji bounded by a major valley or ocean is the entire range of one or more species.

This is clearly demonstrated in perhaps the best known family of plants - the palms. Even in this well known and relatively small group, three new species have been discovered in the last decade. Of the 27 indigenous palms, 26 are endemic (96%) and 12 are known to have a restricted distribution.

Figure 3 shows the localities of some endemic species known from just one or a very limited number of sites, the map is by no means complete. Note that six species (found nowhere else in the world) are found on Mt Korobaba which is immediately downwind of a highly polluting factory, the Fiji Industries' cement works. One of these plants, a small tree *Polyalthia angustifolia* is feared extinct, recent searches for it have been unsuccessful.

With regard to the fauna, only one species the large, probably flightless barred-wing rail is regarded as having become extinct since European contact, probably through the depredations of the introduced mongoose and feral cats. Archaeological evidence indicates that many birds became extinct following the arrival of the first settlers. Even an approximate number will require much more extensive archaeological excavation.

At present several species are vulnerable as a result of relatively restricted distributions.

Other species are rare for unknown reasons - the Fiji burrowing snake, the Fiji petrel, the pink-billed parrot-finch, the red-throated lorikeet and the long-legged warbler.

Introduced plants and animals

Fiji has suffered less than many important archipelagoes from the establishment of exotic plants and animals but their presence is nonetheless very conspicuous. Some were brought by the first settlers to the islands, but the vast majority have come since European contact. Approximately 1,000 exotic

plants are established, amounting to about one quarter of the flora, some of these have become widespread weeds. Fortunately, none have yet threatened indigenous flora in the forest itself as they are mainly restricted to man-modified habitats. However, Kuhl's palm, introduced as a garden ornamental, is now spreading rapidly through the forest in the vicinity of Colo-i-Suva and may yet be a serious ecological threat.

The introduced birds and mammals are essentially confined to converted habitats too, though the mongoose and black and brown rats are found at low densities well into the forest. Whether we would see more native birds, now confined to the forest, in our urban gardens in the absence of mynahs and bulbuls is a subject of debate but as yet no research.

1.5 COASTAL AND MARINE RESOURCES

Significance of the coastal zone

The coastal zone is of vital importance to Fiji's society and its national development. It brings together a unique assemblage of resources such as reefs, mangroves, water, agriculture, sea food, beaches and high quality landscapes. Yet it is also the location of every significant town in Fiji, the majority of villages and the vast majority of the population together with industry and commerce.

The maritime setting

Fiji's national waters cover approximately 1.3 million km² of ocean. The vast majority of the islands arise from the Fiji Plateau which consists of two submerged platforms, the Viti Levu and Vanua Levu Platforms, and is surrounded by deep water except to the south where the Kermadec Ridge links it with North Island, New Zealand. Kadavu and islands of the Koro Sea do not arise from the Fiji Plateau. Depths of 2000-3000 m are found within the Lau Group but are generally less than 2000 m around Viti Levu and Vanua Levu.

Only two shelf atolls, Wailagilala and Qelelevu are found in Fiji waters.

The surface current flows south-westerly through the islands. Water temperatures are always above 20°C with a summer ocean maximum of about 30°C and a mean annual variation of about 8°C. Tidal ranges are very small, neap tides having a mean range of 0.9 m and springs of 1.30 m. Tides are semi-diurnal.

Mangroves

The area of mangroves in Fiji is inadequately known, it has been variously reported as between 19,700 ha and 49,777 ha, while the Forestry Department has historically estimated the mangrove area to be 18,000 ha. The present best estimate is that approximately 42,000 ha remain of an original resource of approximately 45,000 ha with about 6% converted to other uses. However, this is only an approximate figure, as the area of mangrove of some islands has never been measured.

The distribution of mangroves is not even, the largest formations are found in deltaic formations at the mouths of some of the larger rivers - Ba, Rewa, Nadi and Labasa (see Figure 4).

The underlying structure of the mangrove zonation is relatively simple. Climatic conditions are important. In the dry leeward areas, hyper-saline mudflats are a characteristic feature which are virtually absent from the wetter, windward mangrove areas.

Reefs

Reefs are found associated with all the island groups. Many of the reef systems are extensive and complex and include barrier, fringing and platform reefs. The distribution of the major reefs is illustrated in Figure 5.

Two types of barrier reefs are found:

- Oceanic ribbon reefs include the Great Sea Reef, Beqa Barrier Reef, Great Astrolabe Reef and some of the Lau Group barrier reefs, these enclose lagoons or sea areas of normal salinity and their entire character is oceanic.

The Great Sea Reef, extending for over 200 km, is one of the world's major barrier reefs.

- The second type of barrier reef includes reefs which may be exposed, with well developed spurs and grooves, as off Suva, or more sheltered locations, as off Ba. Such reefs are separated from the mainland by a relatively narrow and shallow lagoon channel of neritic nature, which is generally turbid with surface water of low salinity extending out to or even over the reef.

Exposed fringing reefs are found from the southern end of the Mamanuca Group almost to Beqa south of Viti Levu where deep water (over 150 m) is adjacent to the coast. Fringing reefs within the shelter of a barrier reef are very common, they are very different in character to the exposed fringing reefs.

Platform reefs are restricted to shelf waters and are common inside the Great Sea Reef, those of Bligh Waters being particularly extensive.

Reefs are largely absent off the southern coast of Taveuni where the coast plunges very steeply into the sea.

Other marine habitats and coastal features

There has been no inventory made of inshore marine habitats with the exception of mangroves. While there are many sea grass beds, they are scattered and of small relative area.

Of special interest are the marine lakes on Vuaqava and Ogea Driki and on Natewa Peninsula.

Anchialine pools occur in several locations in Fiji, for example Vatulele and at Naweni on Vanua Levu where there are red prawns of great cultural significance. Recently anchialine habitats were discovered in Egypt and Hawaii and both were immediately declared protected areas.

Sea level changes have produced interesting notched formations on many limestone islands and the 'mushroom' islets of the Ogea and Fulaga lagoons which provide a landscape of World Heritage value. On Taveuni, the 'mushroom foreshore' at Lavena has been formed by a combination of receding sea levels, heavy rain and crashing waves.

The drowned volcanic craters of Cobia and Matagi provide superb scenery as do the similar craters on a far larger scale of Totoya and Mutuku.

Fisheries resources

Fiji's living marine resources can be conveniently divided into three main environmental and socio-economic categories:

- . Offshore resources: pelagic and demersal fishes found outside the limits of internal (reef and lagoon) waters. The four main fisheries are pole and lining for skipjack tuna, longlining for albacore tuna, longlining for the larger tunas (yellowfin and bigeye), and bottom lining for deepwater snapper. All of these fisheries take a product destined for export and are implemented by larger vessels. In general, these resources are fished at levels much below maximum sustainable biological yield (MSY).
- . Inshore (reef and lagoon) fin-fish resources: fished mainly at the small-scale commercial, or at the subsistence level, largely in areas subject to traditional fishing rights. Such fish make up the bulk of domestic fish consumption, and are not normally exported.

Over 90 different fish species are commercially important, although 10 species (usually of seasonal abundance) make up over 50% of the catch. Opinion is that this fishery as a whole may be approaching maximum sustainable yields, at least around the larger islands' urban centres.

Inshore sedentary resources: fished mainly at the subsistence level (often reef-gleaning by women) for village consumption, or at the small-scale commercial level to supply non-perishable products (such as dried beche-de-mer, trochus shell or pearl shell) for export. Of the species destined for export several currently appear to be, or have been, fished beyond the level of maximum sustainable biological yield. Over 40 different 'non-fish' species are commercially important, particularly to outer-island economies.

As is common with most other tropical island reef fisheries, overall productivity tends to be lower, and total biomass is split between many more species than is the case in temperate zones.

Outside the reef, skipjack tuna is the most abundant and resilient resource, with an estimated MSY of around 15,000 tonnes from the Fiji EEZ. Indeed, Western Pacific skipjack is probably the only major global fishery left which could sustain major catch increases. Fiji pole and line vessels currently take around 5,000 tonnes per year, and effort is limited by the economics of the pole and line fishery and the need for vessels to return to coastal waters each evening for livebait.

The yellow fin tuna longline fishery has recently been developed to supply high-value fresh fish export markets, and yellow fin has long been a major cannery fish. Current catches are around 2,000 tonnes per annum from the 9,000 tonnes estimated MSY. There are some regional worries about potential overfishing of juvenile yellowfin by purse-seine fleets in the major spawning grounds in the far western Pacific.

The albacore tuna longline fishery is undertaken mainly by chartered Taiwanese boats to supply the one Fiji cannery at Levuka. Around 3,000 tonnes are taken annually from an estimated MSY of 6,000 tonnes. This fishery was recently threatened by massive overfishing of juvenile albacore by the driftnet fishery in the southern subtropical convergence zone, but the recent closure of driftnetting should mitigate any long-term effects.

The remaining major offshore fishery is deepwater snapper, of around 10 species with an estimated MSY of around 1,000 tonnes per year. Deepwater snapper, being non-migratory and comparatively slow-growing, are a more fragile resource than tuna, but current exploitation has been limited to less than 200 tonnes per year.

Inside the reef, the major sedentary species catches are those destined for export, but mangrove crab and rock lobster are also important catches for domestic consumption. One of the major sedentary species is the bivalve freshwater clam, or kai, with an annual catch of around 1,000 tonnes (including shell) from the major rivers (Figure 6). The beche-de-mer fishery, at its height in 1988 probably took around 10,000 tonnes fresh weight from the reef for export (beche-de-mer loses 90% of its weight upon drying).

The major reef fish species caught are spanish mackerel (walu), trevally (saqa), emperors (kawago, sabutu, kabatia), marbled cod (kawakawa), chub mackerel (salala), seaperch (kake), parrotfish (ulavi), bluetail mullet (kanace) and ponyfish (kaikai).

The extent of the subsistence catch (not appearing in the cash economy) is not well-known, but a fairly comprehensive questionnaire survey in 1979/80 estimated that around 15,000 tonnes were taken annually in rural areas at the time. This estimate is in urgent need of updating, since confidence limits were extremely large, and many subsistence fishermen may have since graduated to the commercial sector.

Fishery sector production

Whilst the Fiji Fisheries Division's fish market survey system is generally recognised to be the most comprehensive in the island Pacific, it still falls far behind many other countries, particularly in relating catches to specific fishing grounds. Licenced inshore fishermen are not yet obliged to report their catches. Broad-scale fisheries surveys are made when resources permit, and annual questionnaire surveys have been introduced to enable future overviews of the state of fisheries.

In terms of value (Table 6), the domestic commercial catch was worth around F\$45 million in 1990, whilst imports of fish cost F\$11 million. At least 75% of this imported fish was processed and exported again as canned tuna and total fisheries exports in 1990 were worth around F\$69 million. Fiji is clearly a net exporter of fish with the main export markets being Canada (canned albacore tuna) and the United Kingdom (canned skipjack tuna).

In terms of volume the commercial inshore catch for domestic markets in 1990 was around 6,000 tonnes (4,400 tonnes fin-fish and 1,600 tonnes others), and a broadly estimated 16,000 tonnes was caught and consumed by subsistence fishermen. Approximately 15,000 tonnes of product as fresh-weight equivalent (mainly tuna and beche-de-mer) was fished for export in 1990.

Trends in fishery production

For reef and lagoon fisheries, information is largely lacking on trends in commercial catches of different species before 1978, and even before 1985 this information can not be considered complete. In addition, the almost complete lack of detailed information on the subsistence fishery, and the probable large size of that fishery (possibly the same volume as the commercial fishery) makes a quantitative overview very difficult.

With reference only to the commercial reef and lagoon fin-fish fishery, a simplistic analysis of trends over the past 15 years suggests that increased effort (in terms of vessel registrations and horsepower) is followed by increased catches. There is certainly no marked tailing off of catch following increased effort as is characteristic of overfishing in coastal areas such as the Philippines.

However, the data available are not detailed enough, or on a long enough timescale, to discriminate between a fishery approaching maximum sustainable yield and a fishery with a great deal of development potential. Fiji reef fisheries appear to be in a transitional phase at present. Total commercial finfish catches have been at a plateau since 1987 despite increasing 'leakage' from the subsistence into the commercial sector, and domestic fish-prices have increased by nearly 50% in the same period. It is likely that rapid economic changes since 1987 are a major factor in limiting the expansion of domestic fishing effort, but the Fisheries Division is preparing for a change from a 'development' fishery to a 'regulated' fishery in anticipation of future resource problems. Overfishing would be a severe blow to rural economies.

Rural sector fisheries

Inshore fisheries are extremely important to the rural sector. The average annual consumption of fish products per head in Fiji is over 40kg if imports and subsistence catches are taken into account, and certainly higher in rural areas. Most of Fiji's 600-odd coastal villages and settlements rely on subsistence fishing for a large part of their protein intake. If the estimated volume of the subsistence fishery could be sold at current domestic market prices it would be worth nearly F\$50 million.

It is difficult to separate urban-based small scale commercial fishermen from the total inshore fishery, but it is fair to say that the majority of the small-scale commercial catch for domestic consumption comes from rurally-based fishermen. This small-scale commercial fishery (finfish + sedentary) is currently worth around F\$18 million (although an increasingly large percentage is taken by urban middlemen). Rural

communities often directly benefit by charging annual 'goodwill' fees for access to traditional fishing grounds.

In addition, rural fishermen account for all of the beche-de-mer and trochus taken for export (worth at least F\$5 million in 1990), and several minor export commodities such as pearl shell and lobster. A large percentage of this would accrue to the exporting company, but rural people are increasingly getting involved in their own marketing.

Foreign involvement in the fishery

Fisheries production figures are not easily classifiable by the nationality of the fishermen. However, as a rule, foreign fishermen and companies are only involved in the offshore fishery, and in export processing on the following basis:

- . Currently, 95% of the albacore landed at the Fiji-owned tuna cannery is caught by foreign fishing vessels (either Taiwanese or USA), of which around 50% is taken within Fiji waters. This total albacore landing is worth perhaps F\$10 million, but this fishery does not show immediate prospects for a good enough return on investment to stimulate large-scale local involvement.
- . Foreign interests own at least 50% of the domestic longline fleet established over the past 3 years to provide fresh chilled tuna and snapper for export. This fishery was worth between \$5 and \$8 million in 1990 and is likely to expand further, with an increasing percentage of local investment as foreign expertise and technology is transferred.
- . Foreign investment is the main driving force behind the export of beche-de-mer and trochus but local involvement is rapidly increasing.
- . The domestic inshore fishery, and the offshore skipjack fishery is overwhelmingly dominated by local concerns.

Currently, as in the past, Fiji does not rely at all on income from selling access to foreign fishermen. This is very different from the situation prevailing in the rest of the west-central Pacific where such income can form a major part of national economies. This is mainly due to the lower density of skipjack schools in higher latitude waters, which makes Fiji unattractive to large purse-seiners, but also due to an active Government policy of permitting access only to those foreign fishing interests which are prepared to go into joint ventures, or to land fish on behalf of Fiji companies. The idea is for the economic benefits from foreign fishing activity to be taken in the form of investment, industrial multipliers and the transfer of expertise or technology. This policy is in need of appraisal, but is a major tool in ensuring that foreign fishermen have a stake in the future of

Fiji's fishery resources - more so than if they were simply buying access.

The occasionally dubious benefits of foreign involvement were highlighted when the PAFCO tuna cannery (formerly a Fiji-foreign joint venture) was placed entirely under Fiji government ownership in the mid-1980's and immediately started making profits.

2. PATTERNS OF ECONOMIC GROWTH

2.1 Overview - Changes in direction

Between the end of the World War 2 and 1987 Fiji used some form of development planning as a means of stimulating economic development. Early plans, however, were simply capital development budgets for the public sector. The initiation of more sophisticated planning was closely tied to the introduction by the United Kingdom of the Commonwealth Development and Welfare Grant Scheme. Under the scheme British colonies were required to submit development plans in order to qualify for financial aid. On this impulse Fiji formulated its first Development Plan for the 10 years 1949-1958. Following this another eight development plans were formulated, the most recent being for periods 1971-75 (DP6), 1976-80 (DP7), 1981-85 (DP8), and 1986-90 (DP9).

The development plans established a framework for national and economic development for each of their respective five year periods of operation. Although slight changes in emphasis are apparent from one plan to the next, the overall approach to economic planning was one of protectionism. A wide range of controls and subsidies, including import licensing, protected local industry from external competition. Policy objectives included import substitution and self sufficiency. These policies required extensive administrative intervention to protect import substituting industries and ensure that their profits were not excessive as a result of protection. This administrative intervention led to an emphasis on a planned approach to development. The five year plans were used to plot the growth of sectors and products in some detail and establish the estimated levels of protection, mainly through import licensing, that would give rise to the desired levels of domestic output.

However, following the military coups of 1987 the Interim Government instituted a comprehensive review of economic policy. This review resulted in new government economic policies which emphasise an export-led growth strategy in order to achieve improved standards of living in Fiji. The basis for this new direction is the deregulation of the economy. Under the new policies market response determines the survival of industries and competition controls the level of profit. The role of government is now the creation of a legal framework in which business can be conducted and the establishment of an environment conducive to investment. Immediate strategies which were implemented to achieve these new objectives were the creation of Tax Free Factories and the Tax Free Zone Scheme, and diversification of exports. In broad terms the new policies appear to be responsible for the major resurgence in the national economy following the crisis and events of 1987.

Although there has been a significant change of direction in national economic policy the fundamental basis of national development, from an environmental perspective, remains the same. That is, the significant elements of the national economy (agriculture, tourism, forestry and fisheries) depend on exploitation of the natural resource base. This in turn implies that planning for economic development cannot ignore the need to conserve and manage those resources in a sustainable manner and to take into account the various natural phenomena which affect the productive utilisation of those resources. For example, Figure 7 shows the real GDP growth over the last 20 years. Although there are numerous economic and political factors responsible for the almost cyclical fluctuations in GDP values, environmental factors (cyclones, droughts, floods, etc.) also play a major role in the value of GDP. This can be seen by comparing Figure 7 with Figure 8 (sugar production) where there is a correlation between negative GDP values and a drop in sugar productivity (the major foreign exchange earner until 1990) for the years 1980-82-83-85, which in turn relate to major droughts and other natural events. The current main foreign exchange earner, tourism (Figure 9), is also reliant on environmental factors. Although strongly influenced by global financial economic and political factors on a year to year basis, the industry's ultimate long term success depends on the wise management of its environmental resource base.

2.2 External trade and balance of payment

The Fiji economy is heavily dependent upon international trade and finance. Domestic exports in 1987 stood at F\$334.2 million, an increase of 38.1% over 1986. The average growth of domestic exports during 1987-90 was about 28%; with substantial increases in the value of sugar, fish, timber and garment exports. Total domestic exports in 1990 are estimated at F\$659 million. Despite the dramatic increase in garment exports since 1986, it can be seen from Table 7 that natural resource based production accounted for almost 60% of domestic exports in 1990.

Total imports in 1987 stood at F\$465.1 million, a decrease of 5.8% over 1986. The average annual growth of imports during 1987-90 was about 21%, with substantial increase in the value of manufactured goods, machinery and transport equipment (Table 8). The large increases in the value of imports in 1988-89 have been attributed to the economic recovery in those years. The 27% devaluation of the F\$ in 1987 also had a major impact on the value of imports.

The specific breakdown of imports in Table 9 shows increasing importation of food, energy, manufactured goods and chemicals. The high importation values of automotive fuels reflects the rise in price due to the devaluation and an overall increase in demand for energy in the transport sector. This is also reflected in the large increase in vehicle importation, an almost 300% increase from 1988 to 1989.

Fiji's main export markets are Australia and New Zealand (manufactured goods and sources of tourists) and the United Kingdom (sugar). Japan, Malaysia and the United States are also important markets. Imports are derived mainly from Australia, Japan and New Zealand with significant imports also from Taiwan, Singapore, Korea and the United States. Fiji's economic performance is linked to developments in these countries, particularly the export markets. For example, the price of sugar in the European Community (at which it is sold in the United Kingdom), the contract prices and the world market price determines the incomes received by cane farmers and the Fiji Sugar Corporation. These in turn have an important influence on the rest of the Fiji economy. Trade agreements under SPARTECA (South Pacific Regional Trade and Economic Cooperation Agreement) have assisted in increasing exports to New Zealand and Australia.

Fiji's fuel is sourced mainly from Australia and Singapore. The price of crude oil fell by nearly 50% in 1986 and has since moved erratically. Subsequent expansion of demand caused prices to firm in 1989. Although further falls occurred in 1990, the Iraqi invasion of Kuwait in August 1990 brought about substantial temporary increases in oil prices. These affected transport costs and the general rate of inflation in Fiji.

The Current Account recorded surpluses in 1988-89 after a deficit in 1987, while the trade deficit continued to widen. The surpluses were mainly due to increases in tourist receipts and overseas aid. Tourist receipts on average comprise about 53% of total service receipts, and are therefore a major source of inflows in the Current Account. Since 1987 there has been a continuous increase in government transfers, which comprise mainly overseas aid. However, over the same period there has been a large outflow of investment income and private transfers. After the surpluses in 1988-89, the Current Account showed a deficit of F\$32.3 million in 1990. This included a further deterioration in the trade deficit to F\$251.7 million (Table 10). Some of this was offset by an improvement of about F\$40 million in travel receipts.

The Capital Account showed surpluses of about F\$93.2 million in 1988 and F\$1.1 million in 1989, largely because of increases in direct foreign investment. The overall balance of payments registered a surplus of F\$155 million in 1988, the highest since Independence, while a deficit of F\$0.8 million was recorded in 1989. An overall surplus of F\$52.3 million was recorded for 1990.

2.3 Role of development assistance

Fiji receives development assistance from a number of countries. The value of Grant Aid and Aid-in-Kind received in the 1991 calendar year was F\$45.1 million. This aid contributed 7.0% of Government expenditure for the year and represents around 3.0% of gross domestic product. Although the value of aid received is relatively small in relation to the national budget much of it is used in critical areas where Fiji has shortages of skills or resources.

Fiji is also a beneficiary of preferential trade access to a number of markets, most notably the European Community sugar market. Access to protected markets earns Fiji an estimated premium of F\$132 million over world prices. This premium makes a very important contribution to the nation's standard of living.

The Government of Fiji has always been cautious about international borrowing and it has been careful to ensure that the nation receives genuine value for its investments. This cautious approach helped Fiji avoid the worst effects of the third world debt crisis. It has also meant preferential loan rates that international development banks offer to other developing countries are not granted to Fiji.

For the foreseeable future Fiji will continue to need development assistance, particularly in those areas where there are shortages of suitably experienced local staff.

2.4 Internal patterns of consumption

Figure 10 shows the distribution of weekly per capita earnings for different household locations for each of Fiji's Provinces. The data was collected in 1983 and is therefore dated, however the results are still likely to be a reasonable indication of the patterns of expenditure (Consumption).

The markedly lower expenditure shown for villages reflects the Fijian villagers access to land and ability to grow much of their own food. Their housing is also "rent free".

By contrast the rural Indians live in settlements and generally have less access to land. Typically residents of settlements are more likely to be involved in wage labour or small business. Consequently the nominal expenditure is higher than in the Fijian villages.

Urban dwellers are fully integrated into the cash society and must purchase virtually all their requirements. This explains the high urban per capita expenditure rates.

The difference between the regions reflect the relative level of economic activity in each of the regions. The Central Province includes the capital city Suva. It is therefore a focus of considerable economic activity.

The Western Province includes most of the tourism and much of the sugar production area. Much of Fiji's economic wealth is generated in this Province. This flows through into the highest average weekly earning rate.

The Northern Province also has a substantial sugar growing industry besides timber and agricultural activities.

The Eastern Province is the least developed economically. The Province consists mainly of scattered small islands with little opportunity for wage income and few viable commercial crops. As such average weekly incomes are lower than in the other provinces.

The expenditure data provides a useful starting point from which to analyse welfare but it does not capture the non-cash benefits enjoyed by many Fijian and Indian rural residents. It therefore over states the apparent locational and regional disparities by giving a distorted picture of the relative living standards of the households in the various Provinces and household locations. Although villagers are consistently at the lower end of the expenditure scale they have many advantages over the residents of settlements and those that live in urban areas. The free access to land, building materials and a social support network all reduce the need for cash income.

2.5 Distribution of wealth

Income (GDP at Factor Cost) per head of population increased over the period 1987-90 by nearly 40%, from about F\$1,800 to F\$2,500. In real terms, however, the increase is only about 17% (Table 11). The rise in income per head is the result not only of rises in GDP, but also due to a much slower growth in population than normal, as a consequence of high migration rates.

However, averaging the national income on a per capita basis does not reveal the real distribution of income within the community. As stated in 'Social Indicators for Fiji No 4' (1979):

"In many countries an increase in per Capita Domestic Product is unreservedly considered to be good since, theoretically at least, it enables more goods and services to be available to everyone; in reality in some countries, the rich simply get richer and the life of the majority of the people in the country does not improve and may, indeed, deteriorate.

Thus, although in Fiji the per Capita Gross Domestic Product has increase markedly since 1970 we should ask whether the 'quality of life' for the average person in Fiji has actually improved at the same rate".

The inequality of income distribution was confirmed in DP9:

"According to Inland Revenue data, during the five years 1976-81 period, the share of income accruing to the bottom most decile group, declined considerably. While the total number of people earning up to \$3,000 fell, the share of income accruing to them fell even more, implying greater concentration of incomes in the higher-level income groups. Furthermore, the proportion of income going to the bottom most decile group and the top most worsened from 1:17:4 in 1976 to 1:18.7 in 1981.

The data available also points to the general conclusion that since 1981, disparity between urban and rural incomes has increased."

Again, 'Social Indicators for Fiji No.5 (1989) commented:

"Although the mean average earning for 1985 was \$6692.73, 30.7% of income earners earned more than \$6,000 per annum and between them earned three quarters (75.9%) of total income earned in that year. It would therefore appear that the income was inequitably distributed."

In other words, nearly 31% of income earners received about 76% of total income earned. The UNDP "Human Development Report 1990' stated that:

"Another indicator of inequality is the per capita income of the richest 20% of the population compared with that of the poorest 20%. In 12 of the 23 developing countries where such a comparison is available, the income of the richest group was 15 times or more that of the poorest group".

According to the report 'Poverty in Fiji', the income of the richest 20% in Fiji was 15 times as high as the bottom 20% in 1977. In 1985 the top 10% of wage earners received 50% of all wages earned, while the bottom 10% received only 1%. The same report estimates that 15-20% of people in Fiji are in absolute poverty (where people are unable to obtain sufficient amounts of food, water, shelter, clothing, education and health care to meet basic needs). This estimate is in some way supported by the following statement in DP9:

"According to the 1977 Household Income and Expenditure Survey, about 15% of households were found to be at risk of not having sufficient income to purchase a basic nutritious diet. Analysis made by the Department of Social Welfare further suggests that the incidence of poverty was higher than the number of officially

recognised destitute families in Fiji".

2.6 Conclusion

In an evaluative system developed for 11 Pacific Island countries by the Australian International Development Assistance Bureau, Fiji is the only country placed in Category 1: Self-sufficiency. This is based on the relatively high standards of living and incomes, a skilled workforce, good services and infrastructure, and a relatively high level of economic independence and viability. It is also, relative to other Pacific islands except Papua New Guinea, the most well-endowed in terms of natural resources.

However, the primary production orientated nature of the economy means that Fiji must husband its natural resources in a conservative manner and prepare plans for natural events which can drastically affect economic productivity. If a 'sustainable' approach is taken then Fiji will continue to be an economic development leader in the South Pacific.

3 POPULATION AND DEMOGRAPHY

3.1 Historical population changes

In 1874, the year of Cession, the Fijian population is believed to have been about 135,000 and declining as a result of devastating diseases which came with European contact, notable among these was the infamous measles epidemic of 1875. After proper procedures were established, the first census of April 1881 gives an official figure of 127,486, of which 114,746 were indigenous Fijians. In the censuses which followed, the Fijian population continued to decline until 1921, when they numbered their lowest figure of 84,475 in a population totalling 157,266, which by then also included 60,634 Indians, indentured labourers brought by the British to work in sugar cane plantations. The indentured labour system was practiced from 1879 to 1916.

The Indian component continued to increase to outnumber indigenous Fijians by 1946, owing to higher growth rates. By 1966, however, this trend reversed, giving Fijians a higher growth rate Table 12. One of the factors involved was a decline in Indians fertility.

3.2 Recent population changes

The decades 1966-1986 saw significant demographic changes in the Fiji population, with a decline in fertility amongst both Indians and Fijians. The decline in Total Fertility Rate (TFR) has been dramatic for the Indian component in particular, with the TFR declining from 5.51 children per woman to 2.77 children, a decrease of 50%. The TFR among Fijians declined by 26% over the same period, from 5.58 children per woman in 1966 to 4.14 in 1986.

Although the Indian fertility decline had in fact started well before 1966 and the advent of official campaigns, the introduction of a family planning campaign by the government in 1962 and the establishment of a very active Family Planning Association of Fiji in 1963 helped greatly. Family planning acceptance obviously appealed to a higher proportion of Indians than Fijians, evident from numbers visiting the clinics. The Ministry of Health figures show that family planning acceptance rates amongst Fijians was 18.7% in 1986, whilst amongst Indians it was nearly twice as high at 35.6%.

The impact of the family planning campaign has waned in recent years. Ministry of Health figures (1989) show that birth rate among Fijians has remained stagnant at about 30 per thousand while Indian numbers suggest further decline.

3.3 Future changes

Migration

Migration, predominantly of Indians following the political upheavals of 1987 have had a major impact on future population projections.

The total population of Fiji has been projected up to the year 2011 taking the age structure of the 1986 population as a base for all components.

Actual migration numbers, for all ethnic groups, have been accounted for up to the end of 1990 (about 10,000 annually), thereafter a fixed rate is assigned at 50% of the 1989/90 average (which amounts to 5300 annually); a declining rate of fertility is assumed for all, Fijians more gradually to reach a TFR of 2.5 at the end of the period while Indians TFR is assumed to reach 2.0 by then; slow improvement in mortality has also been assumed. This projection showed that the total population up to the end of August 1991, coinciding with the fifth year after the last census of 1986, will total 737,200. This will consist of 365,400 Fijians (49.6%) and 339,000 Indians (46.1%), and 32,200 others (4.4%). Towards the end of the period in 2011, if movement in the fertility, mortality and migration rates remain at the assumed level the total population would increase to 874,000 persons of which 499,500 or 57.2% are expected to be ethnic Fijians, and 349,600 or 39.9% will be Indians (Figure 11).

Labour Force

Because of the massive migration numbers (nearly seven per cent of the 1986 total population would have emigrated by the end of August, 1991), the average growth rate over the next 20 years is likely to be less than 1 per cent, halving the rate between 1976-1986. In spite of this there is likely to be a massive increase in the size of the population aged between 15 and 64, because of the compounding effect of even small increases over time (Figure 12).

Demographically, the labour force (here used interchangeably with the economically active population) is that category of the population whose function is to produce goods and services needed to satisfy the requirement of the whole population. The size of the labour force is therefore, some proportion of this population category (the 15-64 age group). In primitive economies work is only constrained by health, family size, ex-roles and the need for money. But when agriculture is commercialised and non-agricultural employment increases to make wage labour dominant, other economic factors start to play a greater part in the level and pattern of labour force participation. Therefore, entrants to the labour force are likely to be affected not only by the size of the 15-64 age

group but also by the increasing proportions who participate, especially women. Information collected from surveys are notorious for understating women's participation in economic activity.

The labour market will experience a flood of numbers as large cohorts of currently younger population move into the 15-64 age groups towards the end of the projected period. Numbering 418,600 during 1986, this group is projected to increase by 40% to 586,900 in 2011. At the other end of the spectrum, if fertility gradually declines among Fijians, as assumed, the younger population (those below age 15) will stabilise and begin to decline toward 2011 to number 237,000 from a total of 273,500 in 1986, easing demand on classrooms and teachers.

During 1986, among Fijians the proportion of the economically active population was 85.6% for males and 27.8% for females and 86.2% and 17.9% respectively for Indian males and females (Table 13).

Dependency burdens reduce in such a situation, where nearly two-thirds of the population are in the 15-64 age group (Table 14). This, however, is a transitory stage when 'ageing' is occurring and if mortality conditions improve further, larger numbers of the population will survive into older age.

Figure 13 shows the changing age composition of Fiji's population based on the assumptions used in the projection for 1991 and 2011. The steeper sides of the population pyramid are due to the stabilised size of the birth cohorts. If this continues for a life span, a population will have nearly equal proportions in most age groups.

3.4 Population distribution

Viti Levu, Fiji's largest island, is where 75% of the 715,000 population live. The second largest island of Vanua Levu, only half the area, has 18%. Only a third of the islands are populated. Figure 14 illustrates the population distribution.

There were 39.1 persons per sq km during 1986 when averaged over total land area of Fiji, an increase of nearly 14 persons per km over the preceding 20 years. The density increases are particularly high in those provinces which include urban centres and/or are sugar-cane farming areas (Table 15). Suva City now has 760 more persons per km than in 1966. Similarly owing to increases migration into the urban corridor between Suva and Nausori, Rewa and Naitasiri provinces also show marked increased in density. Ba and Macuata both contain urban centres as well as cane growing areas and thus show increases. On the other hand the densities of outer island provinces such as Lau and Kadavu remain relatively unchanged on account of people moving to Viti Levu and this is most significant from Rotuma. With the forecast population increase, the average number of persons per km in Fiji is

expected to increase to 45 persons by 2001 and 48 persons by 2011. While these changes may appear small their impact on resources could still be significant as they are mere averages and do not highlight pressures on specific areas.

If densities are calculated per km² of arable land population pressure on land would certainly appear accentuated at densities in excess of 170 per km².

In Fiji little has been done to identify environmental degradation vis-a-vis population pressure. However, with the almost complete utilisation of first class arable land, the current expansion of agriculture into marginal hill areas and steep lands will continue and increase. In such a situation even small population increases can begin to dramatically expand localised land degradation.

This will be accentuated in the proximity of fast growing urban areas, particularly Suva. Urban growth will tend to generate its own pace of hinterland agricultural expansion, irrespective of the land capability.

3.5 Conclusion

Fiji has a modest population size and growth rate. However, local population movements, in particular urban drift and the small area and uneven distribution of good agricultural land is currently and will increasingly cause localised demographic imbalances which have potentially serious environmental implications.

Recent socio-political events have led to considerable emigration, particularly of the Indian component of the population. This will have a significant impact on the former population trends, and also makes any future projections uncertain. Nonetheless, there will certainly be a large increase in the potential labour force (those aged between 15-64) over the next 20 years.

4. NATURAL RESOURCE USE AND ENVIRONMENTAL ISSUES

4.1 Urban Environment and Environmental Health

The urban environment

The urban population (statutory cities and towns plus peri-urban areas) increased by nearly 120,000 between 1966 and 1986 at a rate which well exceeded the overall population growth rate, such that the proportion of the population living in an urban environment increased by 5.3% from 33.4% to 38.7%.

The needs of increasing urban and peri-urban populations are not confined to the provision of basic services (eg, housing, water, sewerage) which are currently overextended and under-resourced in most if not all localities, but the effects extend out into the rural hinterland and to the land use and agricultural activities of smallholder farmers.

Building in Fiji takes many forms from residential to commercial and heavy industrial. The traditional bure which is well adapted to the local climate but requires considerable maintenance is rapidly being replaced by more substantial wood and iron buildings or by concrete constructions. Because of the increase in the urban population there has been a major expansion of residential subdivision, as well as an expansion in industrial buildings.

Fiji has, in the past, been badly affected by tropical cyclones and hurricanes, which have caused tremendous damage. There is a major dichotomy in the controlling regulations between rural villages and urban or semi-urban areas which prevents a uniform application of standards.

The new building codes, incorporating the National Building Code and the Home Building Manual, have been developed with cooperation between Fiji's Building and Standard Committee and various involved authorities. These codes are yet to be enacted by the Cabinet.

Almost 39% of the population live in urban areas and the proportion and growth rate are both increasing.

Forecasts indicate that during the coming 15 years, the urban housing stock will have to increase by nearly 19,000 houses in order to accommodate a moderate population growth. In order to meet this rapid growth in urban housing demand, the total annual construction for new urban houses as well as upgrading to existing stock is expected to rise by 50% from some 2,000 to nearly 3,000 units per year, between 1991 and 2006. Residential subdivision in the past have frequently been poorly planned and controlled, even those by statutory authorities. The most notorious being the Davuilevu Subdivision, now a barren, treeless moonscape whereas formally it was lush rainforest.

Of relatively recent concern, especially in Fiji, is an awareness of the accelerating loss of buildings of heritage value and transformation of the urban landscape. The attractive old towns in Fiji such as Suva and Levuka still have an appealing and charming character, which reflects the historic townscape and socio-cultural traditions of the South Pacific. For many people Suva is the embodiment of a rare, unspoilt garden city. Suva's intrinsic character is well worth protecting before the buildings and way of life are irretrievably destroyed, through overdevelopment and lack of landscape controls.

Environmental health

One of the advantages of Fiji's position as an isolated island nation is the absence of many of the world's serious diseases. The majority of the population enjoy excellent health.

Fiji is fortunate in being free from the worst of the tropical diseases. Dengue fever and filariasis are present but both are rarely fatal. Yaws was once common but has now been eradicated, while dysentery and typhoid fever are now rare. Only sexually transmitted diseases and 'lifestyle' diseases are currently increasing. In rural areas of Fiji where 100% of the domestic water supplies and domestic wastes are not treated, water-borne diseases such as typhoid, dysentery, leptospirosis, ascariasis, diarrhoea and ancylostomiasis do occur sporadically. The spread can be largely attributed to either poor hygiene practices or the use of contaminated water.

Dengue fever (see Table 16) and filariasis are the two important mosquito borne diseases prevalent in Fiji at the present time, although incidence of both is sporadic. Fiji also experienced an outbreak of Ross River Fever in 1979 in which about 50,000 people were affected. Malaria and a number of other mosquito borne diseases are absent from the country.

Major developments such as irrigation for agricultural farm land to boost the country's economy also pose some danger by way of creating ideal breeding sites for mosquitoes. Examples of projects known to facilitate mosquito breeding include fish farming and rice production.

Adoption towards production and consumption of canned food and poor disposal of such empty cans also contributes towards the promotion of domestic mosquito populations.

Poor management of dump sites for disposal of solid waste also poses a threat by providing vector breeding sites. For example mosquitoes, flies, rodents, etc. The present Suva rubbish dump has been found to breed vector mosquitoes.

Dengue is spread by Aedes aegypti which is the prime vector and is very highly domesticated. This species is found throughout the country and breeds freely in artificial containers such as tyres, drums, empty food cans and flower vases. Aedes albopictus, which is another strong vector of dengue has been introduced into Fiji recently through importation of tyres from southeast Asian countries.

Industrial areas can also create ideal situations for mosquito breeding, for example keeping of derelict vehicles.

Dengue is endemic in Fiji and at periodic intervals the outbreak of the disease is experienced. Occasionally deaths occur. Figure 1 shows the incidence of dengue in last five years.

Through PHC and public participation, control is directed at source reduction. However, mosquito populations vary with seasonal and climatic changes and on occasions the mosquito indices show the presence of mosquitoes in very high populations which poses a high risk of transmission of arbo-viral and other mosquito borne diseases. In such situations, the National Vector Control Unit advises the respective local authorities to take appropriate action on source reduction.

Guppies (Poecilia reticulata) are found in abundance in Fiji, particularly in drains and pools. This fish contributes significantly in the control of mosquitoes. Other bio-control agents such as bacteria (Bacillus thuringiensis) and fungus (Ceolomomyces sp.) etc. have also shown some promising results through mosquito research carried out by the National Vector Control Unit.

Nationwide insecticide spraying campaigns are mounted, particularly following natural disasters such as cyclones and flooding to reduce the risk of transmission of arbo-viral disease. Truck mountable ULV LECO spraying machines and motorised mist blowers are used to dispense Malthion ULV (technical grade) and Malathion 50 percent E.C. Simultaneous programmes of larviciding using Temephos is also carried out to control immature stages of mosquitoes.

Water supply

Access to safe, clean freshwater supplies for all is an important national objective to which considerable resources have been allocated.

Solid and water wastes, air and noise pollution

Fiji's rapid rate of urbanisation has resulted in major problems and development requirements for the disposal of solid and water wastes. It is also the principal cause of

increasing air and noise pollution. These issues are examined in 4.11.

4.2 Agriculture

Loss of mangroves

Large scale reclamation of mangroves, recurring and popular 'development' sites, has proved to be economically unviably and resulted in considerable national financial losses, in addition to the loss of mangrove benefits to the local subsistence villages.

The erosion situation

Although anecdotal information and casual field observations indicate that extensive soil erosion does occur in Fiji, there are few quantitative data available.

However, recent data on erosion plots indicate soil losses corresponding to 22-80 tonnes/ha/yr on slopes of 5-29°, in a sugarcane growing area north of Nadi. In studies in a vegetable/root crop growing area in the wet zone measurements corresponding to soil losses of 12-2300 tonnes/ha/yr on slopes ranging from 5-25° were obtained. The very high value corresponded to a plot having a very long slope (more than 25 m) with bare ground. The sediment load in the Waimanu River indicates that the average soil loss for the catchment in which there is much recent agricultural expansion was about 53 tonnes/ha/yr corresponding to a loss of 2-2.5mm soil per year. These values are particularly high given that the catchment is heavily forested.

In the Waimanu catchment, as in most other catchments, one important erosion feature is the instability of the steeper slopes. Landslides are clearly visible on steeper slopes throughout the Fiji Group; a major rainstorm in April 1986 caused some 620 landslides in the Waimanu catchment alone.

An annual soil loss of 24-79 tonnes/ha/yr equivalent to soil losses of 1.6-5.3 mm/yr was estimated by a recent review of a variety of catchments in both the wet and dry zones, while yet another review using a different technique estimated soil loss from 10-170 tonnes/ha/yr. These catchments varied in the extent of their agricultural development.

Field observations on soil loss using erosion stakes or profile reference points revealed soil losses of 90-300 tonnes/ha/yr for areas where forest or indigenous grassland were converted to intensive sugarcane production. As with virtually all erosion, the material lost was from the surface layers of the soils, leading to considerable depletion of organic matter and valuable plant nutrients.

All the measurements and estimations made so far leave considerable scope for error. However, it is clear that the already high rates of erosion that occur naturally on Fiji's steeper lands are considerably increased by human action.

It is ironic that in international agricultural circles, Fiji is widely quoted as having pursued a most successful soil conservation programme, based on the use of vegetative contour bunds using vetiver grass. A video partly filmed in Fiji is being used to demonstrate the effectiveness of vetiver grass to farmers in developing countries around the world.

Unfortunately the truth of the situation is rather different.

A very successful vetiver grass programme was indeed pursued by the sugar industry prior to its change of ownership to the Fiji Sugar Corporation. Although in obvious need of maintenance, vetiver bunds are clearly visible today, 20-40 years after they were planted, throughout the older cane growing areas.

Unfortunately, the expansion of cane growing in the 1970s and early 1980s into marginal, hilly terrain was undertaken without any vetiver grass planting. Yet it is here that it is most obviously required. It is here that areas of cane are going out of production at an increasing rate. One can commonly see cane planted on slopes of over 40%, and more often than not the cane is noticeably thinner on the upper slope - the telltale sign of soil loss.

But nowhere to be seen are the vetiver bunds which are urgently needed.

Economic implications

Given the difficulties in obtaining accurate measurements of the physical extent of soil erosion, it is not surprising that there have been only a few attempts to carry out the more abstract measurements of the relationship between soil loss and economic loss in Fiji. Qualitative observations point to erosion damage and lowered plant productivity on sizeable proportions of many individual fields, with patches of severely diminished productivity. Sugarcane farmers, for example, have complained of declining yields and have blamed this on the quality of the fertilizers imported. Testing of fertilizer materials indicates little or no change has occurred. A more logical explanation of the decline in yields (despite maintaining or increasing fertilizer applications) is the impact of erosion on soil productivity.

A variety of crops suffer erosion-induced production losses; spatially and economically, sugarcane and ginger grown on slopes are the most important.

Sugar cane

The advance of sugarcane onto slopes over the past 25 years has been the result of an economic imperative to increase national yields and rested in part on the development of new varieties that would produce reasonably well on marginal lands.

Ginger

In contrast, the severe erosion associated with ginger cultivation, which is almost entirely cultivated on slopes, results from agronomic considerations of ensuring good drainage and of practicing quick land rotation to avoid nematode infestation. The ginger industry can be considered a test case for the Government's stated resolve to promote sustainable agriculture and curb land-degradation. Currently there is encouragement and satisfaction at both the sectoral and national levels for the ginger industry, expansion is desired and being promoted, but the industry is clearly based on unsustainable agricultural practices, and these need to be eliminated.

Subsistence gardens, some of which have been pushed onto steeper slopes by the expansion of cash crops and cattle on the flatter lands, also suffer from erosion, especially where traditional mulching practices are no longer practiced.

Off-site ecological and economic damage from induced erosion is also serious. Notable in Fiji is downstream flooding and sedimentation, which extends to the coral reefs, whose high level of marine productivity is threatened by the land-based activities that cause erosion. Here again, quantitative estimations of loss are not available, and the situation is complicated by the decrease in mangrove ecosystems, which also lessens reef productivity. Anecdotal evidence suggests that sedimentation on reefs is becoming seriously harmful in some areas. There is no doubt that logging-induced erosion in water supply catchments has, on occasion, damaged the water supplies of Ba and Labasa, two of Fiji's major towns; or that there is the potential for harmful logging-induced sedimentation in the much larger reservoirs of Vaturu and Monasavu, the latter of which is Fiji's principal source of hydroelectricity.

Social attitudes and land tenure

In Fiji, as elsewhere, the farmer/land manager at times acts under the influence of a conservationist ethic while at other times other expediencies take precedence. Even prehistorically both possibilities are evident. The earliest inhabitants of Fiji caused erosion and serious land degradation by burning and cultivating on slopes; but they also, perhaps as an adaptation to the damage they or their ancestors had earlier caused, developed irrigated, sustained-yield terraces for cultivation of *Colocasia taro*. Today, some

subsistence farmers apply conservationist practices such as mulching and non-burning, but others farm in ways that induce erosion or other forms of soil degradation.

Central to land conservation measures in Fiji today is the country's land tenure system, whereby some 83% of the land is 'native land' held under customary, communal tenure by land-owning groups (mataqali) of ethnic Fijians. This land, which is administered by the Native Land Trust Board (NLTB), cannot be sold but some of it can be leased to non-Fijians (and to Fijians as individuals). Plots of land leased under NLTB procedures account for much of the land used in Fiji's system of smallholder sugarcane cultivation, wherein most farms are about 1 ha. The lack of long-term security of tenure, particularly as it applies to the Indian majority of cane farmers is often blamed for the lack of conservation practices in cane fields. Although other factors are involved (for example farmers like 'clear' fields and so burn the cane trash rather than using it for mulch), the tenure situation is significant and likely to become more so towards the mid-1990s, when many of the leases will fall due for renewals. Tenants (both Indian and Fijian) are apprehensive that they will lose land that they may have held for as long as thirty years; consequently, they are reluctant to carry out improvements or strive for sustained-yield capabilities that may end up passing on to the landlord. The resolution of this lease-renewal issue is a critical political and, by extension, conservation problem for future land-based developments in Fiji.

Future action

The recent awakening in Fiji's government circles to the need for integrated watershed management is one sign that qualitative and quantitative facts about soil erosion and its economic implications are beginning to be transformed into political facts that motivate countermeasures. It is perhaps the more widely appreciated extent of deforestation rather than piecemeal erosion from cultivated fields that is behind the concern for watersheds. But agriculture, nonetheless, needs to be a key component of any 'integrated' watershed management.

Soil erosion and land degradation should not, however, be viewed solely as an environmental issue. In Fiji, today they are clearly not, they are the visible manifestation of profound social issues. Initiating effective soil conservation measures which tackle the environmental issue are urgently required, but they alone will not solve the underlying problem.

Although the close relationship between the Fijian people and their land is continually emphasised, there is in fact a generally low level of awareness at all levels of the need to husband soil resources and its fertility. This is in apparent

contrast to the marine environment where traditional fishing rights owners are very conscious of and often vigorously protect their rights and resources, without Government assistance. If Fijian landowners (some of whom are also the worst offenders) were to become more aware of the consequences of unsustainable farming practices on the land they lease, then more control would ultimately be effected.

4.3 Forestry

Deforestation

Deforestation in Fiji is moderate but continuing. Since 1967 an estimated 90-140,000 ha (11-16%) of the nation's forests have been converted from forest to non-forest land use. Deforestation appears to be occurring at a nominal rate of between 0.5-0.8% per year from a 1967 base of 838,000 ha. On these figures indigenous forests now cover from 700,000 to 750,000 a or 43-45% of the islands of Fiji (note the area discrepancy in comparison with Table 9.1, the above figures are based on the most detailed, but not comprehensive, examination of deforestation yet undertaken and just completed by National Environment Management Project).

These figures are not so severe as to cause immediate concern about the disappearance of the forests of Fiji. However, there is a severe imbalance in the distribution of forest with the drier parts of the larger islands and many of the smaller islands having suffered severe deforestation. In such areas even a moderate loss of forest lands can be too much.

The most significant losses appear to be occurring in the western half of Viti Levu - particularly the Sigatoka and Ba River valleys and, increasingly, the upper Wainibuka catchment; the Dreketi area of north-western Vanua Levu and many of the smaller islands, including Beqa and Kadavu. Forests in these areas are under continuing pressure from agents of change, both human and natural.

There are four principal causes of deforestation in Fiji - clearing of forests associated with large scale commercial agriculture/rural development projects; the continuing small but steady growth of small holder mixed commercial and subsistence farming; the continuing spread of small settlements, urban growth and the infrastructure to service them (roads, dams); and fire. Sound planning, good legislative controls and management guidelines can mitigate the effects of all of these. Only fire has a large unpredictable element which can only be countered by education and public awareness.

The exploitation of the forest for timber is also a factor in deforestation. Logging in itself does not necessarily reduce forest cover. Unsuitable or poor logging practices, however, can and do affect the ability of forests to regenerate. There

is evidence that such practices both within and outside logging concession areas have significantly affected forest quality and diversity to the detriment of both forest cover through erosion and, subsequently, forest-based and other industries.

Plantation forestry

Fiji has embarked on some highly successful plantation establishment programmes. The softwood plantations total over 43,000 ha and are established in the main in the drier climatic zones, as afforestation in areas of degraded grass and reedland. In contrast the hardwoods, principally the introduced hardwood, Mahogany *Swietenia macrophylla* has been established with great efficiency within the existing native forest and now covers some 42,000 ha (Figure 15).

Environmental impacts of the plantation programmes

The establishment of the softwood plantations have had, in balance, overwhelmingly positive environmental impacts. Rare exceptions being the reduction in dry season stream flows which have affected a few villages. In contrast, the hardwood plantation programme has potentially adverse environmental implications, and little attempt has been made to examine these.

The principal environmental considerations of the hardwood programme are:

- . The silvicultural procedure adopted is not 'enrichment' as is commonly claimed, but will inevitably lead to the conversion of TMF to a monoculture plantation of an exotic species.
- . The principal hardwood species to be planted is mahogany *Swietenia macrophylla* which is proving remarkably vigorous in some Fijian localities. The possibility that mahogany may invade native forest and disrupt its ecology requires consideration.
- . Conversion of TMF to an open habitat has a devastating effect on Fijian wildlife especially many rare endemic species which are native forest dependant.
- . For convenience sake, establishment of plantations is following logging. If this is continued it will result in an unacceptably high proportion (25-33%) of Fiji's richest TMF (Production Forest) being lost.
- . This establishment pattern under-represents a comparatively large (greater than 30%) of Fiji's TMF resource which is degraded or non-commercial.

. Use of a highly toxic poison (Arsenic Pentoxide) is used, even though its use is banned in many countries. An independent monitoring programme has recently been commissioned to monitor its impact.

. Planting appears to be proceeding irrespective of considerations of slope (greater than 50% in some cases) and right up to stream banks. This has serious implications for harvesting.

It is clear that environmental guidelines covering all aspects of the establishment of hardwood plantations need to be introduced.

Developments in the forestry sector

The sector strategy

The forestry sector accounts for just under 2% of GDP with forest products being the fifth most important export. There is expected to be a large increase in the sectoral contribution to the national economy as pine and mahogany plantations mature over the next decade. Export earnings are expected to rise from \$32 million (1989) - to \$100 million in year 2000.

In 1988, a comprehensive review of the forestry sector and the policies for its development was undertaken by 11 national and international consultants with the objective of formulating a strategy for the development of the sector for the next 25 years.

Principal findings with respect to the resource was that expansion of the resource base by afforestation and reforestation, as an integral part of a systematic capability-based plan for rural land use, could safely go as far as doubling the present areas of pine and hardwood plantations, to an area of approximately 200,000 ha.

That would take afforestation by pine (and eucalypt possibly) to 120,000 hectares and hardwood reforestation in the indigenous forest to 100,000 hectares, leaving around 60,000 hectares for timber production under a natural management regime. But there is a degree of uncertainty in such a scenario.

'Judging by the rate at which conversion seems to be occurring, the defacto assumption in current forest management of 200,000 hectares as the sustainable area for timber production could well be optimistic.' Forestry Sector Review (FAO, 1988)

To an increasing degree therefore the timber production potential will depend, as planned, on afforestation, on conversion of non-commercial indigenous forest to plantation and reforestation after harvesting to increase the productivity of the indigenous forest.

The strategy suggested an export driven orientation for the industry which was regarded as the only way that the sector could lift its contribution to the national economy, such that it would approach those of sugar and tourism.

Conservation and the environment

The sector review stressed that:

'One aspect of the potential of the indigenous resource in particular is worth special attention. This is the slight regard given in practice to the nationally and locally important environmental value of the forest cover. Given the topography, geology and climate of most of Fiji, protection of the watersheds, the streams and the soil resources is fundamental to the future of the country and its people. In the rush for development, this fact of life seems to be too often forgotten'.

Forestry Sector Review (FAO, 1988)

Two features of this relationship have to be considered in a strategy for the development of the sector. They are:

1. Protection and the prevention of damage to the still existing forest cover.
2. Rehabilitation of the damaged forests and deforested land with environmental significance.

With regard to the first, and to some extent, the second, deficiencies in present policies and practices which must be corrected include:

- . The ease with which protection forest can be logged through the loop-hole of agricultural development.
- . The ease with which stream flow, soil erosion and ecological considerations can be disregarded in logging.
- . The inattention given in some logging operations to legally established reserve areas.
- . The ease with which de-reservation can be effected.

. The difficulty of bringing areas of ecological significance, even at the international level, under protection before they are disturbed or destroyed.

As far as the second is concerned, the role of afforestation primarily for land rehabilitation has to be taken as seriously as for timber production.

The sector review supported the current designation and management classification of forest into Protection Forests, Production Forests and Non-commercial Forests as ecologically desirable and nationally important.

Implementation of the sector review

There have been some significant achievements in implementation of the sector review, although some of the recommendations still require action. Most notably with regard to the environment is the adoption of a National Code of Logging Practice, with training courses being undertaken firstly by Ministry of Forestry staff to be followed by private contractors. There is also a specific endeavour on the part of the Ministry of Forestry to ensure that Protection Forests are no longer the target of occasional incursion.

Logging and wildlife

Current logging practices in Fiji cause a great deal of avoidable environmental damage, this is readily observable to anyone who inspects logging operations and it would be totally unacceptable to the international environmental community. It is only accepted in Fiji because of the absence of an environmental lobby which can pressurise the authorities to act.

The adoption of a National Code of Logging Practice is a welcome move, but it is clearly only as good as its enforcing officers.

The root causes of environmental damage from logging are:

- . the management practice of mandatory extraction of a large number of species down to 35cm;
- . insufficient control of logging operators;
- . the use of inexperienced and badly equipped contractors for logging operations; and
- . the prevalence of uncontrolled 'secondary' logging.

The principal deleterious impacts of logging are:

. **Increased soil erosion**

Logging inevitably causes soil erosion and contributes to stream sedimentation. However the amount of soil erosion is dependant on logging practice and is strongly influenced by the kind of land being logged. It has been suggested that approximately 80% of sediment in the major rivers is probably from natural erosion, a consequence of highly erodible geology and topography and highly erosive rainfall patterns. Whilst in general removing trees has much less impact than roading and skidding.

. **Regeneration and vegetation damage**

The damage to trees and vegetation remaining after logging always looks severe, but many forest species in Fiji have a remarkable ability to recover. A legacy of their survival and evolution in a cyclone prone environment.

There have been only two short term investigations undertaken in Fiji, on this issue. They provided encouraging results on the ability of forests to regenerate to a semblance of their former diversity and composition.

However, this evidence is clearly insufficient with regard to the vitally important question of what happens to the forest vegetation after logging. The absence of any long term and even medium term research programme to monitor this is a serious deficiency.

. **Loss of wildlife habitat**

There have been no controlled field studies on the effects of logging on wildlife, although recently a team attempted to investigate the effects of logging on the Silktail *Lamprolia victoriae* in Vanua Levu. Its findings were uncertain. However, the following are general findings from experienced observers:

1. Fiji's fauna is small in number but has a high level of endemism (more than 30% in all well studied groups with the exception of bats).
2. The native fauna of the larger islands is primarily adapted to forest and all endemic species on Viti Levu, for example, for which information is available, inhabit forest; the majority are restricted to forest or forest associations.
3. Altitudinal and regional differences in faunal distribution within the remaining primary forest on Viti Levu appears to be minimal; Moss Forest being an important exception in the butterflies and moths, at least.

4. Restricted ranges of many plant species is well documented, which makes the flora particularly vulnerable to poorly managed logging.
5. Despite the initial environmental disturbance caused by logging, there is no evidence, at present, to indicate that selective logging will cause the extinction of any vertebrate fauna, provided suitable refuge areas remain unlogged. However, habitat conversion from TMR following clear-felling causes almost total loss of endemic forms.
6. Undisturbed Protection Forests are crucial to the long-term survival of Fiji's wildlife.
7. The present management of Protection Forests is inadequate and this has serious implications for the long-term conservation of Fiji's wildlife.
8. Reforestation of logged-out Production Forest with exotic hardwoods will have more serious long term consequences for wildlife than selective logging.

Management and planning implications

Environmental concerns

It is clear that environmental management and control within the forestry sector is very weak. To date, production, development, revenue and cost considerations have prevailed over the conservation and environmental aspects in the sector to such an extent that future productivity of the forests and efficiency in soil and watershed conservation is seriously threatened.

If this is to be reversed there needs to be a major strengthening of supervision and law enforcement.

The effects of logging on wildlife are largely unknown but the indications are that most species are quite resilient, testimony to their evolution in cyclone ravaged forests. However, restricted distributions in the flora are common place which makes them very vulnerable to logging and deforestation.

Of perhaps the gravest concern is the inadequate management and control of Protection Forests for it is these areas of fragile and vulnerable forests which may hold the key to the long term survival of Fiji's wildlife and to the proper functioning of water catchments.

Deforestation is an immediate issue for the forest industries which will want to protect and enhance the long-term viability of the forests to sustain their activities. It is also a wider environmental issue with a range of direct and indirect costs

benefits to society. Forest cover is an important factor in the protection of watersheds and stream and soil quality. Areas of importance to forest production or of ecological significance must be identified, enumerated and monitored. Where deforestation has occurred in such areas action is required to enhance reforestation and rehabilitation programmes.

Development direction

Development strategies of the forestry sector conform closely to the Government's macro-economic objectives, specifically market-led growth, deregulation, privatisation and increased public participation. All of these have serious environmental implications unless Government retains and exercises responsibility for environmental control.

Loss of environmental control in the recently privatised pine industry has already resulted in economic loss and hardship through the siltation of the Ba municipal catchment and disruption of its water supply. A salutary example - revenue cost considerations will always prevail over environmental and social concerns unless Government retains the initiative.

A strategy to control deforestation must include the means to determine the distribution, quantity and ongoing quality of existing forest resources and monitor their use. Thus the National Forest Inventory now being undertaken should not only measure the existing forestry resource but put in place an ongoing monitoring capability.

The threat of 'green' bans on hardwood timber from the Pacific and its products is very real and could seriously disrupt the industry. This reinforces the necessity for Government to exercise direct environmental management within the sector.

Fisheries Resources

Culture

Aquaculture methods, both freshwater and marine, have been subjected to investigation and development by the Fisheries Commission for at least 20 years, with varying degrees of success. Fiji has no tradition of fish-farming, and the main effort has been to stimulate interest at the grassroots level, particularly in linkage with inland nutritional needs.

In general, the commercial development of aquaculture in Fiji has been predicated on production of high-value species for export. However, Fiji cannot compete on equal terms with Southeast Asia in intensive aquaculture for export. In particular, labour and transport costs are much higher. With preferential access to certain markets for Fiji products, and the introduction of financial incentives to export-oriented

population cannot claim 'ancient precedent' to the ownership of any qoliqoli and where, with a comparatively high level of urbanisation, many city-dwelling Fijians have effectively become disenfranchised.

4.5 Freshwater Resources

In most areas water is not regarded by the public as a scarce resource and waste is commonplace. Even in areas subject to frequent water shortage water conservation is sometimes lacking. Community awareness and discipline in such situations needs to be upgraded.

Urban water supply systems

All of the 12 major urban centres in Fiji are supplied with piped water supplies with completely satisfactory physical and chemical treatment to comply with health requirements. Consumers are metered and rates are levied according to rate of consumption. The Ministry of Infrastructure and Public Utilities (MIPU) administer this role and manages the piped water system. This involves about 60,000 K1 serving a population of over 330,000.

Quality of water in major urban centres is always bacteriologically satisfactory. But at times there are shortages when prolonged droughts are encountered and occasionally technical failures occur as a result of very high sediment loads in rivers - as recently occurred at Ba because of inappropriate logging in the catchment. All metered supplies receive some degree of water treatment, from minimum chlorination to comprehensive dosing, sedimentation and filtration. The two largest plants include fluoridation.

Surveillance of water quality is the Ministry of Health's role. The Ministry's pathology laboratory at CWM Hospital carries out regular bacteriological monitoring of drinking water supplies. Chemical monitoring is carried out by the National Water Quality Laboratory of the MIPU located at Kinoya. World Health Organisation Drinking Water Quality Guidelines are used as there are no national drinking water standards. Similarly there are no standards for recreational and other classes of water.

Peri-urban water supply systems

The MIPU is also the supplier of piped water systems in peri-urban areas. They manage and charge the rate of consumption to consumers. Treatment of water is limited to storage and chlorination, which at times may be chemically contaminated and shortage of demands are often encountered. The Ministry of Health carries out surveillance of water quality as explained above.

Rural water supply systems

Water supply systems in rural areas are either communally or individually owned. The management role is not under ministerial responsibility, although MIPU undertakes technical responsibility. 52% of the population live in these areas and the supplies are normally not treated. Health problems arising in rural water supply schemes are normally due to:

- . Lack of quality control.
- . Insufficient quantity for average daily water demands.
- . Inadequate maintenance of piped water systems.
- . Lack of funds for new installations and maintenance.
- . Lack of technical expertise at the village or rural area level.

Utilisation of groundwater

In terms of total volume only a small fraction of Fiji's reticulated supply comes from groundwater. However, the situation is changing as knowledge of the resource grows and groundwater is beginning to be regarded as a viable option and not merely the last resort when all else fails.

On some of the islands, supply is either totally or partially from groundwater. Rotuma, Vanuabalavu, Lakeba and northern Taveuni are examples of areas where boreholes have been drilled by Government. A large percentage of the island tourist resorts in the Yasawas and Mamanucas use some groundwater from shallow bores or hand-dug wells. A number of these supplies are often affected by saline intrusion and so its use is usually restricted.

The use of groundwater for irrigation of cash crops is growing (Legalega pawpaw farm, Sigatoka Valley Rural Development Project). The growth of tourism has major short to medium term implications in the field of water supply (for example supply for the Natadola Tourist Development Project where groundwater might be the only viable option in the short term).

Although overall reticulated groundwater use has been low on a national basis an increase in demand is envisaged.

Pollution

Pollution of surface and ground water from agriculture, domestic and industrial activities has not yet been recorded as a problem. This may be due more to non detection rather than the absence of a problem.

Contamination of coastal aquifers from saline water intrusion remains one of the major threats to resource management. This can occur from over pumping of boreholes and wells in coastal areas and on small islands.

Management and planning implications

The majority of Fiji's population have access to safe, clean water supplies all the year, a notable national achievement. Some locations, however, experience frequent, sometimes annual, shortages. In such situations, there is a need to further develop groundwater supplies and where possible extend reticulation from existing sources.

Island water supplies, especially the smaller ones and limestone islands provide more profound problems. Since tourist developments with large water requirements are frequently located in such sites the problems can be heightened. Groundwater will increasingly play a major role in such sites, but proper management of extraction is essential if the supply is to be used sustainably. In addition, safe recycling of water needs to be promoted.

Rural communities in such locations require greater awareness of water conservation needs and the structures to store rainfall which on an annual basis, is only rarely in short supply.

4.6 TOURISM

National significance

Tourism in Fiji experienced a spectacular rise between 1965 and 1973, when the number of tourist arrivals increased about 20 per cent annually, reaching 186,000 in 1973. After a slump following the energy crisis, the number of arrivals started to increase again. Between 1975 and 1985, the increase levelled off at an average rate of nearly 4% per year.

With the increase in the number of arrivals, the tourist accommodation capacity in Fiji also increased. At present there are about 4,000 units of accommodation (rooms, cottages, etc.), up from 700 in 1965. Gross receipts from tourism increased at an annual rate of 9.4% between 1975 and 1985, with total tourist expenditure amounting to \$192.1 million in 1986.

In 1987, a combination (not necessarily related), of political events and decisions by major airlines to reduce or terminate services to Fiji resulted in a reversal of the upward trend in tourism growth that had started in the last quarter of 1986. Visitor arrivals fell by 26%, from 258,000 in 1986 to 190,000 in 1987.

The recovery, however, was rapid with the industry generating gross earnings of \$281 million in 1989, compared with gross earnings of \$215 million from sugar, and accounted for 17% Gross Domestic Product. By 1990 tourist arrivals increased to 279,000 with gross earnings estimated at \$336 million.

Tourism currently provides in excess of 74% of Fiji's foreign exchange earnings. Although the industry experienced a phenomenal growth rate in 1989/90, it is considered that a realistic on-going growth rate will be around 8% per annum.

Tourism has provided a sustained platform for employment, employing approximately 25,000 people or 30% of the total paid national employment figure. Although most of the employment is currently highly localised around the western region of Fiji, the tourism industry has great potential to deliver economic benefits to rural Fijians.

Visitor's perceptions of Fiji

At the heart of Fiji's tourism resource base are its people and its natural attractions. The combination of these has resulted in the industry-wide use of the term: the 4 S's' - smiles, sun, sand and sea. However, many visitors to Fiji are not aware of the options relating to off-site leisure and adventure activities and the industry, in general, has significantly failed to exploit these.

Nonetheless, a visitor survey conducted in Fiji during 1989/90 revealed that the scenery was recorded as among the most favourable impressions of their visit to Fiji.

Environmental management issues related to coastal tourism.

The coastal/marine resources attributes of Fiji are those which have been most developed by the tourism industry. Many environmental management issues have arisen which are interconnected. These issues can directly affect the viability of particular developments and, in the long term, the credibility and effectiveness of Government tourism strategies, as well as local economic and social benefits derived from the developments.

Following is a summary of some of the major environmental management issues related to coastal tourism in Fiji. Some of these issues concern direct impacts on the environment by development (A), others involve impact on the development by the environment (B), while others relate to impacts on social/cultural values (C). It is significant that most of the issues given as examples involve more than one type of impact.

. Loss of ecological values (A)

Loss, in some areas, of significant environmental features (especially biological habitats) through resort construction (coastal reclamation, dredging, removal of terrestrial vegetation) and associated infrastructure (airfields, roads).

. Loss of fisheries (AC)

Subsistence fisheries are a nationally important feature of nearshore coastal ecosystems. Some resort construction has resulted in significant loss of mangroves, the most biologically productive of coastal resource ecosystems. Although traditional fishing rights owners have been financially compensated since 1974 for loss of fishing resources, the adequacy of such an approach over the longer term remains questionable.

. Coastal processes (ABC)

One of the most significant impacts associated with coastal tourism relates to disruption of coastal processes. Coastal tourism, by its very nature, attempts to capitalise on the attributes of coastal resources and features. Unfortunately, this has led, and continues to lead, to developers disregarding the need to understand the physical characteristics of their chosen development site. Consequently, resorts have been built too close to the shoreline and/or in lowlying areas and are subjected to damaging storm surge, especially during cyclonic conditions, which can result in expensive repairs and loss of revenue. Others, in a misguided attempt to 'deal with' coastal problems have constructed high cost sea walls and groynes, which not only fail to resist the forces of the sea in storm conditions but even under calmer prevailing conditions result in loss of beaches, one of the main attractions for tourists.

. Climatic change (AB)

Related to coastal process issues is the predicted sea level rise associated with global warming. Current studies already indicate a relative sea level rise in Fiji. If developers fail to take this factor into account their developments could be increasingly subject to the impact of storm surge flooding and erosion within the economic lifespan of their developments. Conversely, in part recognition of the need to overcome such potential problems, one major resort developer applied for a dredging licence in 1989 to remove sediment under 140 hectares of mangroves to raise the level of the development area, thereby creating another set of environmental problems.

. Potable water (ABC)

Availability of potable water on smaller outlying islands is a major environmental constraint on tourism development. Many resorts in these locations rely on storage tanks replenished by barging water from the main island, as well as rainwater catchment systems. Of major concern are proposals to obtain water by sinking bores into the thin freshwater lenses on

small islands, especially where traditional settlements already exist. Depletion of the (usually) small freshwater aquifer can have detrimental effects on island ecology and deplete a scarce resource utilised by local villagers who tap springs or dig wells.

. **Waste disposal (AB)**

Disposal of solid waste and sewerage effluent is an issue of obvious concern in tropical coastal environments where detrimental effects on the environment and, in turn, the development can result if inappropriate methods are used.

. **Loss of tourist environmental/cultural resources (ABC)**

Lack of adequate environmental planning and management by developers has resulted in damage to, or loss of, the very environmental and cultural features which form the basis of the tourism industry. For example, hotel construction in the 1970s resulted in heavy sediment runoff which killed many nearshore coral colonies on the south coast of Viti Levu. A famous tourist and traditional cultural site on the island of Vatulele, where tourists come to see red prawns in anchialine pools, has been subjected to physical disturbance of the habitat and graffiti on rock faces. Other direct impacts associated with tourism operations include: anchor damage to, and trampling of, reefs; damage to lagoonal ecosystems by recreational speed boats; and depletion of living marine resources to supply the tourist trade with coral, shells, and turtle shell.

. **'Traditional' activities (B)**

As traditional fishing rights are protected (unless a developer makes a specific agreement with the owners of the rights), such activities can still occur on reefs adjacent to resorts. This can lead to depletion of marine life (a significant 'tourist resource') in these areas.

. **Ecological disruption (ABC)**

Some coastal tourism activities result in significant impacts on the environment, the tourism industry and public health. For example, an increase in fish poisoning, notably ciguatera, has been linked with disturbance of coral reefs, including blasting of boat channels; toxic anti-fouling paints (organotins) used on marine craft are known to be a serious ecological threat to marine life; deepening of shallow, nearshore lagoon habitats to create safe swimming holes adjacent to resorts in Fiji has resulted in 'invasions' of long spined sea urchins and anemones, negating the purpose of the excavation.

. **Loss of public recreational resources (C)**

The rapid development of tourism in Fiji has resulted in the alienation of many good quality, accessible coastal locations from the general public. Although the statutory requirement for a 30 metres shoreline setback for development attempts to overcome this problem by guaranteeing public right of way, the reality is that this provision does not address the problem.

Social/cultural constraints limit the effectiveness of local-tourist intermingling at resort locations, and infrastructure (car parking, change rooms, tables, etc) is generally unavailable to local users.

The link between tourism and protected natural areas

Two seemingly divergent global trends are becoming increasingly inter-linked. One is the growing demand for 'specialised' tourism and, in particular, tourism to protected natural areas. The second is a shift in strategies for protected areas management.

In Fiji where there is as yet no system of national parks and protected areas, the establishment of any such areas will be very much at the discretion of the landowners who will rightly require an income equal to or greater than any other potential land use. For this reason tourism has a major role to play in current and future attempts to set up a national parks and protected areas network. This is very much in line with the current move by park managers away from the strictly protectionist method of national park management to one based on integrated development activities, of which nature tourism is increasingly a major component.

Initiatives in the establishment of tourism linked protected areas in Fiji.

Fiji has three ongoing initiatives in linking tourism with landowner developments for protected areas:

- . Tavoro Forest Park at Bouma on Taveuni;
- . Waikatakata Forest Park and Archaeological Reserve, Nadroga;
- . Tavuni Hill Fort, Nadroga.

Other initiatives based on developing tourist activities in areas with significant natural attributes including Namenalala Island, Namuamua Inland Tours and Vasuitetava Canoe Cruises. All of these have one important component in that they encourage the active participation of landowners in the tourism industry and the national economy.

Management and planning implications

It is clear that Fiji is currently at a crossroads in both the specific area of tourism development and in terms of overall national development. The country took the road to successful tourism development in the early 1970s and now, 20 years later, is reassessing the role it will play in the future.

Although tourism should not necessarily be strengthened at the expense of other sectors it is vital that its key role in the country's development is recognised. Concomitantly, given that tourism is supported by cultural and environmental resources, it is essential that national development in general, and tourism in particular, are based on sound environmental planning and management principles. In short, tourism, environmental management and conservation are mutually compatible and interdependent aspects of sustainable development.

Clearly the environmental resources which support the tourism industry must be conserved and managed if the industry is to continue to play a major role in the national economy. At the same time the greatest ally for environmental conservation in Fiji could well be appropriately sited and managed tourism development and activities. Such development offers the opportunity to provide social and economic benefits to Fijian communities whose only other options may be environmentally degrading and potentially non-sustainable activities such as large scale logging operations.

The success of the current initiatives at Bouma, Waikatakata and Tavuni is most important not only for the tourism industry but also for protected area management and the future establishment of a nationwide network of parks and protected areas.

4.7 MINING

The Emperor Gold Mine

. Economic considerations

The Emperor Gold Mine is a well-established mine which has been operating for nearly 50 years and produced over 115,000 kg of gold. Earnings from exports make gold Fiji's third largest foreign exchange earner after tourism and sugar (approximately \$38 million in 1989-90). Gold production averaged 2,025 kg between 1983-87, then increased sharply to over 4,200 kg in 1988 and 1989. Total employment at the mine is about 1600 with an annual payroll of over \$10 million, the Government of Fiji receives a similar amount annually in taxes and electricity tariffs. A township of nearly 5,000 people has developed at the mine site and is totally dependent on the mine for its existence and future. Production is from both open cut pits and from the five underground workings.

. Environmental considerations

There are two potentially serious environmental hazards in the operation of the Emperor Gold mine:

- . gaseous discharge from the smokestack which if improperly controlled could liberate significant quantities of sulphur dioxide and arsenic; and
- . the effluent from the tailings ponds if poorly controlled could have unacceptably high concentrations of suspended solids and hazardous levels of cyanide.

Other concerns include high levels of suspended solids in the mine pumping operations which are discharged directly into the Nasivi River and possible bund failings of the old and now unused tailing dams, of which there are several at the mine.

An environmental impact report of the Emperor Mine was prepared by an ESCAP consultant in 1981.

. Current environmental monitoring

The Department of Mineral Resources currently samples the Nasivi River and leachate from the tailings dam on a regular basis. The samples are analysed for a broad spectrum of pollutants. The data is held on file by the Department and not published.

Sand mining by Fiji Industries Ltd

Fiji Industries Ltd operates a cement manufacturing plant at Lami for which they require a large quantity of calcium carbonate as raw material. This is obtained by dredging coral and alluvial sands from Laucala Bay.

. Economic considerations

Fiji Industries Ltd is 95% owned by a subsidiary of Fijian Holdings Ltd which represents Fijian provincial and government interests. The company employs approximately 150 people and has an annual turnover of about \$14 million of which \$1.5 million represents nett foreign exchange earnings. Current production is approximately 80,000 tonnes of cement annually, and the operation has been running at a loss for several years although previously was very profitable.

. Environmental considerations

Fiji Industries require approximately 1.5 tonnes of sand for each tonne of cement, the current requirement is approximately 120,000 tonnes annually and this is obtained by a continuous dredging operation in two locations in Laucala Bay, one at the inner edge of the barrier reef and the other in an area of

alluvial sediment. Current reserves are estimated at seven to eight years. Although the dredging operations have been the subject of a major study, no environmental impact assessment has been undertaken and no post or during operation monitoring is undertaken.

The environmental concerns of the mining/dredging operation are:

- . damage caused to surrounding habitats by the fine sediments disturbed during dredging;
- . change in water circulation and processes; and
- . changes in the marine food resource base following modification of the substrate.

The Fiji Industries cement plant is better known for its highly conspicuous smoke stack and plume and the regular heavy pollution from dust and particulates. In addition to the concern over particulate levels in the discharge, there are additional concerns of gaseous discharge, in particular sulphur dioxide.

The operation has not been the subject of an EIA nor is regular monitoring undertaken.

Management and planning implications

The mining sector is exclusive private with government involved in regulatory activities, one of which is environmental control.

Environmental issues at the existing Emperor Mine need to be distinguished from social issues relating to living conditions and the single employer nature of the Vatukoula township. Nonetheless with the Tavua township downstream from the mine and a major area of mangroves at the mouth of Nasivi River, environmental control of mine effluents needs to be stringent and subject to public scrutiny.

Initially a new mine at any one of the existing prospects will have major positive economic benefits locally and nationally. There is a danger that environmental and social consideration may be considered negotiable in efforts to encourage mining investment. Events on Bougainville Island in Papua New Guinea should be a sufficient warning of the possible consequences of such an approach.

4.8 INTRODUCED PLANTS AND ANIMALS

The significance of strict quarantine

Invariably whenever new organisms are introduced to an alien environment, whether accidentally or intentionally, they arrive without their natural enemies or competitors that

normally keep them in check. Indeed when introducing new crops or domestic animals it is the function of quarantine to see that this is so.

Fiji like most other remote Pacific Island nations has a restricted flora and fauna when compared with the continental land masses. These plants and animals have, over thousands of years developed their own systems of checks and balances through indigenous natural enemies and competition. Introductions of new organisms into such systems cannot fail to be significant and it is not possible to accurately predict what will happen in each case.

Fiji is very fortunate to be without many of the world's most serious diseases and pests, but more than 50% of the important plant pests and more than 75% of the weeds of Fiji have been introduced since European contact. However, there are many more pest organisms present elsewhere in the world which could become established if they were introduced.

There is a risk of pest introduction whenever a ship or aircraft arrives from overseas. Containerised cargo transport has considerably increased the chance of accidental introduction of pests. Trade in agricultural commodities, tourism, and the introduction of new crops all pose serious risks of pest introduction. It is the function of quarantine to facilitate all these essential activities while minimising the risks involved.

Pests of quarantine significance to Fiji

Agricultural pests

The list of plant diseases not present in Fiji but which could become established if introduced, is very long, Table 17 provides a list of some of the more important ones. The introduction of any one of these could have severe economic implications for farmers and the nation.

Fiji is particularly fortunate to be free of many of the world's worst animal diseases, including: foot and mouth disease of cattle, goats, sheep and pigs; Newcastle disease of poultry; and rabies which affects most mammals including man. These diseases could be easily introduced through the careless importation of domestic or wild animals, of poorly processed fresh meat, or of untreated livestock products. There is no doubt that the establishment of any one of these diseases would have serious implications for the local meat industry and potential future exports.

Health threats

Fiji is most fortunate to be without malaria, the world's most serious tropical disease. It is a potentially fatal disease which is a scourge in neighbouring Vanuatu and the Solomons. If the vector mosquito became established here, then inevitably the malaria parasite would follow and the disease could become established. That such a scenario is possible has already been partly confirmed by the recent establishment of *Aedes albopictus* in Fiji from southeast Asia where it is a strong vector of dengue fever.

Ecological threats

Fiji has been fortunate that with the notable exception of the mongoose, the introduced birds and animals which have become naturalised have failed to have a major detrimental effect on native species. Rather they have become established in disturbed habitats - urban, agricultural and the like.

However, this is not always likely to be the case and the chances that a new arrival might ecologically displace a native species is very real. A prime example is the Ring-neck Parakeet unwisely imported to the Bird Park at Sigatoka. The Parakeet is established as an exotic in over 40 countries worldwide and in Fiji it could very easily compete with the Kula, a bird of great national and scientific importance. The Ring-neck Parakeet is, in addition, a serious agricultural pest in most countries to which it has been introduced.

Examples of breaches of quarantine

There are many examples of breaches of quarantine in Fiji, of particular note are the following recently established pests:

. The dalo beetle

This beetle is endemic in Papua New Guinea, Solomon Islands and Vanuatu where it is a serious pest of dalo, and a minor pest of sweet potato and banana. It was first discovered in Fiji in 1984. It had undoubtedly been here for some time before that as it proved impossible to eradicate even after a massive campaign.

The pest is now well established in southern areas of Viti Levu and is spreading to other dalo producing areas. Unfortunately natural enemies of this beetle are unknown even in its area of origin and control can only be effected with pesticides.

This pest affects not only yield and quality of the crop but also imposes limitations on Fiji's ability to export to those countries where the pest is not present.

. The spiralling whitefly

This insect is endemic to South and Central America and was introduced to the South Pacific in the early 1980s through Hawaii. It arrived in Fiji in 1984/85 and caused serious damage to a wide range of crops, including tomatoes, egg plant, bele, guava, and cassava. Farmers had to resort to frequent pesticide sprays to control the pest.

In 1986, a parasitic wasp which keeps the pest in check in Central America was imported and within 12 months had the outbreak under control. Pesticides are no longer required.

. Aedes albopictus - Dengue vector

Recently the southeast Asian mosquito Aedes albopictus which is a strong vector of dengue fever was discovered in Fiji. It is believed to have been introduced through importation of tyres. Since dengue fever is one of the most important diseases prevalent in Fiji today, the establishment of a new vector is particularly serious.

. Pine engraver beetle

In 1982 the pine engraver beetle was discovered in the pine plantations of western Viti Levu. The beetle, a native of the mediterranean countries is a serious pest in pine plantations of Cyprus and Israel and recently in South Africa where it was introduced and has become established. Its appearance in Fiji, so far from its native distribution was both surprising and mysterious. To date it has not proved a pest to pine but this cannot be taken for granted yet. There are many instances of pests which have had insignificant impact for many years before suddenly undergoing a population explosion.

Management implications

The absence of many pests and diseases in Fiji provides the nation not only with a healthier environment than many countries enjoy but provides it with many economic advantages. These advantages include the absence of costly control measures and the ability to grow crops and livestock in a manner in which many countries are not able to. A vivid example of this are Fiji's valuable hardwood plantations of mahogany. Such plantations cannot be grown in the countries where mahogany is native because of the presence of the tip-shoot borer.

4.9 ENERGY

The interface between energy and the environment highlights the difficulties between securing environmental protection and achieving development objectives. Energy has always been seen as essential for development, although the often quoted linear relation between the two has been questioned in recent years.

Fiji has many small scale industries as well as a large tourist sector and the dominating sugar industry which lead to complicated energy demands. The energy demands of the industrial commercial sector are superimposed on a background of domestic energy consumption. The domestic sector is split between the energy concerns of the largely electrified urban population and the often non-electrified rural population; of which many live in quite isolated outer-island communities. In the major urban centers the household demand can be similar to that in any developed country, in rural villages the household demand can be very basic, amounting to cooking and lighting only.

The detailed energy demand in Fiji has been the subject of a number of surveys. One of the first of these surveys in 1977 looked at energy use in selected rural areas. This survey found that over 90% of householders, in rural areas, cooked over an open fire and that over 70% used kerosene or benzine lamps for lighting. The Nadi-Lautoka area was the subject of another survey in 1982 which detailed the energy use in over 900 households and 150 commercial and industrial establishments. A similar survey looked at the use of energy in urban areas in Suva where over 1000 households and 160 commercial and industrial establishments were assessed.

Common to all sectors of course is the need for transport and thus the requirement for a supply of liquid petroleum fuels. As well as the need for land transport Fiji requires considerable energy supplies for air and sea transport.

The energy demand for the country is met by a mix of imported petroleum fuels and locally derived renewable energy resources. The renewable energy resources consist mainly of bagasse generated by the sugar industry, wood used mainly for domestic cooking and agricultural drying, and hydro-electricity. There has been some interest in alternatives such as solar, geothermal, wave, biomass to electricity conversion and OTEC, but as yet the commitment to such sources has been small.

The mix of supply in Fiji is unusual in that in terms of direct energy units, that provided by bagasse tends to dominate due to the large relative size of the sugar industry. In terms of cost the imported liquid petroleum fuels dominate. Table 18 gives the energy supply figures for Fiji in quantities. Figure 18 shows the split in terms of direct energy units (joules). This figure however, does not take into account the various efficiencies of conversion or the 'quality' of the energy concerned. The biomass fuels, wood in particular, tend to be used inefficiently and so their net contribution to useful energy is considerably lower than indicated. Electricity on the other hand is a 'high quality' energy resource and is nearly all generated from hydro power in Fiji. To generate the same electricity using diesel power generators would require about three times the energy equivalent in fossil fuels.

Petroleum imports

Although there has been some minor exploration for oil in Fiji no hydrocarbon resources have been found and today Fiji relies totally on imported petroleum products for its liquid fuels. Some years ago there was a suggestion that Fiji should acquire its own refinery but this option is now generally regarded as not economically viable due to the scale and the makeup of the demand. Thus the fuels are shipped as refined products mainly from Australia and to a lesser extent Singapore. Due to the very small scale of the supply to the South Pacific in relation to the greater Asia Pacific region the resulting logistic problems lead to relatively expensive landed prices.

Fiji as one of the larger consumers in the region, acts as a redistributing center to many of the smaller island nations in the South Pacific and so the volumes going through the terminals are generally greater than the retained imports. In addition to sales redistribution, Fiji also bunkers fuel for the airline industry (about 100 million litres/yr) and a sizeable fishing industry (30 million litres/yr). In 1990 the total imports to Fiji terminals amounted to some 460 million litres of which about 210 million litres or 45% went out of the country, leaving 250 million litres consumed locally (retained imports).

Table 18 shows the breakdown, according to product type, of the retained imports in terms of volume (or weight) for the years 1983 to 1990. Table 19 shows the same information in terms of joules. The anomalous figures for aviation turbine fuel for 1989 and 1990 and the sharp increase in kerosene in the same years can be explained by the fact that they are in fact the same product. The provisional Fiji Bureau of Statistics data have mixed the two categories. Data from the oil companies themselves give the actual figures for domestic kerosene consumption at around 20 million litres/year (1990) with the balance of the dual purpose product - (DPK) going to the airline industry as jet fuel, the bulk of which is 'exported' by airline carriers operating out of Nadi airport.

Figure 19 illustrates the change in retained imports over the last eight years. The decrease in Industrial Diesel Oil (IDO) after 1983 reflects the coming on-stream of Monosavu hydro and the corresponding phasing out of diesel based generation of electricity in Viti Levu. The increase in other products (mainly Automotive Diesel Oil, ADO and Motor Spirit, MS) has resulted in the nett retained imports being at roughly the same level in 1990 as in 1983.

Transport

Transport is an energy use sector which traverses industrial, commercial and domestic sectors. Efficient transport of goods and persons is a necessary part of the development

infrastructure of any country. In Fiji's situation as an isolated oceanic archipelago the transport sector is particularly important.

Coastal shipping handles between 50,000 tonnes and 100,000 tonnes of cargo and 60,000 to 90,000 passengers per year. Together with locally based fishing it is estimated that about 30 million litres of petroleum fuels are used by coastal shipping.

The domestic use of aviation fuel accounts for less than 2% of the retained petroleum imports. The energy used for international air transport cannot, however, be easily apportioned to energy used in Fiji. Air Pacific currently uses around 10-11 million litres per annum of jet fuel (Avtur, Jet A1 or DPK) but this does not include the Boeing 747 service which is fuelled by Qantas.

In 1990 land transport energy accounted for three quarters of all retained petroleum imports and just over a quarter of the total energy used in the country. The number of motor vehicles has been increasing steadily over the years with some fluctuations, notably a slowdown during 1987/88. Table 20 shows the registered vehicles from 1985 until 1990. There are now over 75,000 vehicles on the roads increasing at about 5% per annum. The petroleum consumption figures give an average rate of use of fuel per vehicle of about 45 litres a week. This relatively high unit consumption probably reflects the high proportion of public transport (buses and taxis) used in Fiji compared to private vehicles.

Electricity production

The supply of electricity to consumers in Fiji can be split into that supplied by the Fiji Electricity Authority (FEA) and that supplied to rural consumers by the Public Works Department (PWD) and private concerns. The former is by far the larger, accounting for all the major grid areas in the main islands: Viti Levu has the highest demand with the greater Suva area and Nadi-Lautoka being the two main consuming regions. Prior to 1982 the demand was met by diesel based generators.

Between 1982 and 1983 the major hydro scheme at Monosavu on Viti Levu came into operation. The present (1991) generating capacity is 80 MW at Wailoa power station. Wailoa is connected via a 132 kV transmission line to both Suva and Vuda (Nadi-Lautoka). The scheme, though small by world standards, is by far the largest single energy project in Fiji and one that deserves particular attention from an environmental point of view. It is instructive to note that no comprehensive EIA was undertaken prior to the construction of the dam; some work was carried out by USP staff in 1977 and 1979 but no real monitoring of the area began until 1982/83. The early monitoring was done on an ad hoc basis but since 1985/6 the

Institute of Natural Resources at the University of the South Pacific has been commissioned by FEA to carry out regular monitoring of the dam's water quality. Though viewed in hindsight the scheme has been free of major environmental problems and the country has benefitted from decreased petroleum imports and a non-polluting source of electrical energy.

Forty three per cent of Fiji's households are connected to the FEA grid, although there is considerable effort to extend the grid further into rural areas the low demand in these areas limits the economic viability of such extensions. About 80% of FEA's capacity goes to the commercial industrial sector with domestic households getting the remaining 20%. The 1989 peak demand was a little over 62 MW from the Monosavu based grid. As of 1989 the total FEA installed capacity was 159 MW with the FSC and Emperor Gold Mine having a small additional capacity. The excess capacity over the demand being the diesel capacity in existence before Monosavu came on line. Figure 20 shows the electricity production for the years 1983 to 1989.

Rural electrification

Rural electrification includes both FEA grid extensions and stand alone generation. As mentioned, the main problem with grid extensions are economic. In some cases aid/loans have been negotiated by the Fiji Government to ease the cost burden, such as the Chinese funded (interest free loan) grid extensions in Rewa. On the smaller islands and areas remote from present grid lines stand alone systems are the main option. The core of such systems are provided by diesel generator sets, typically with capacities of between 3.5 kW and 40 kW. These systems are designed primarily to provide lighting and (very) limited appliance use only for households in remote villages. There are currently 170 village based subsidized, diesel generator sets maintained by the PWD in Fiji.

Hydropower

In addition to the main Monosavu scheme there are a few small hydro power systems in existence or near completion. The largest (800 kW) is under construction by Chinese engineers at Wainikeu in Vanua Levu. Others include a 11kW system at Bukuya, a micro system at Tutu training center in Taveuni and a small system at Nosogo in central Viti Levu. The Wainikeu project when completed will be connected to 8 villages and to 300 consumers in Savusavu. The DOE has identified up to 80 potential sites for small hydro systems on the two main Fiji islands. There is also potential for medium sized systems (10-20 MW) in Viti Levu, with hydro being connected to the present Vaturu Dam water supply system, as one alternative system being considered.

Biomass

Fiji has extensive biomass reserves including approximately 750,000 ha of indigenous forest, 101,000 ha of forest plantation (pines and hardwoods) and some 66,000 ha of copra plantations. Wood and wood wastes (including coconut husks) are mainly used for domestic cooking and drying agricultural produce. In rural areas, where an open fire is the most common method of cooking food, the per capita consumption of firewood has been estimated to be around 350 kg per annum. In peri-urban and urban areas this value drops to 200 kg and 50 kg per annum respectively. Copra drying uses approximately 150 kg per annum per capita in rural areas and industry uses an estimated 25 million kg per annum of which FSC uses around 10 million kg.

The other source of biomass comes from the sugar industry in the form of bagasse. As of 1990 Fiji had about 70,000 ha of land under sugar cane which yielded a little over 4 million tonnes of cane in the 1989 season. This quantity of cane produced 460,000 tonnes of sugar leaving about 1 million tonnes of bagasse as a byproduct. There are four mills operating: Lautoka, Rarawai, Labasa and Penang. Most of the bagasse (95%) is burnt in the mills to produce steam for the mill, with each tonne of cane requiring some 700kg of steam at 100°C. In addition some steam is used to generate electricity for the mill and, in the case of the Labasa mill and the Penang mill, some excess electricity sold to the FEA. Further sales of electricity by the FSC from the Lautoka and Rarawai mills are hampered by the fact that the FEA has surplus hydro power on the main grid and therefore little incentive to purchase more.

There has been limited interest in developing small scale biomass to electricity systems in Fiji. There were several wood gasification plants considered under the 1984 EEC energy program but none of these eventuated due to perceived difficulties with operating a relatively untested and new technology. Two small steam reciprocating engines exist in Taveuni, one is located on a copra plantation and produces steam for copra drying and to operate a 15kW 'Skinner' steam engine. The other plant is a smaller version operating a 10 kW Skinner steam engine in Navakawau village and also drying copra.

There are about 50 sawmills operating in Fiji, processing some 400,000 cubic meters of roundwood. With wastage during milling of the order of 50%, there is thus considerable potential for using the waste wood for energy production. In 1984 the FEA purchased a Fluidyne gasifier for evaluation; they subsequently decided, however, that the technology was too problematic and the unit is now sitting idle at Vuda. One of the major operators Tropic Woods, has recently installed a cogeneration facility to produce electricity for its own use

and heat for timber drying and treatment. Other sites for biomass to electricity production are being considered at sawmills in Vanua Levu and elsewhere in Fiji.

Other energy sources

. Solar energy

In remote areas where the electricity demand is low, photovoltaics can compete with small diesel generators as possible sources of rural electrification. The solar regime in the Fiji Group varies somewhat according to the prevailing weather pattern. In the drier areas in the west of the two main islands and on many of the smaller islands it is thought that average annual insolation levels of around 18-20 Mj/m exist whereas in the wetter areas facing the prevailing weather the levels drop to around 14-15 Mj/m. The difference between summer and winter is not substantial, amounting to around 6 Mj/m.

Due to the relatively high initial cost of photovoltaic (PV) systems many of those put into rural areas have been subsidized by either the Government or aid funds. Since 1983 about 350 PV systems have been installed by the Fiji government in rural areas but with only a limited success.

Solar-thermal hot water heaters are common in urban and institutional situations but their high cost has prevented wider dispersal. The tropical climate in Fiji also means that water heating is generally not a high priority among much of the community.

. Wind

The prevailing winds to the Fiji group are the southeast trades which blow most of the year with some abatement in the summer months, but the local wind regimes are not well known. It is thought, however, from the limited meteorological data available, that the situation may be marginal at best, around 4-5 m/s average annual. Some measurements indicate that in isolated best positions, average annual windspeeds may reach around 6.5 m/s. The region is also susceptible to hurricanes in the summer months.

. Geothermal

There are about 40 known hot springs or surface manifestations of geothermal activity in the two main islands, all associated with fault zones surrounding several volcanic centres. The springs on Viti Levu vary between 40-60°C whereas those on Vanua Levu are somewhat higher at between 60-100°C. No evaluation of the geothermal energy potential is available.

Other sources

Ocean based energy resources, such as wave power and OTEC, are readily accessible to Fiji but are not as yet proven to the extent that they might be seriously considered as viable options. The Department of Mineral Resources (DMR) in conjunction with SOPAC are investigating the situation and participating in joint data gathering exercises with the Norwegian government and other agencies.

Management and planning implications

Fiji has benefitted greatly from the commissioning of hydroelectricity from the Monosavu Dam. Industrial diesel oil imports dropped by two thirds saving about \$20 million in 1984 in reduced imports. However, the construction of such a large project without any form of environmental impact assessment is a precedent which it would be wise not to repeat. This applies to the possible use of the existing Vaturu Dam for hydroelectricity. Careful assessment not only to the physical impacts needs to be made but in addition other potential land uses, in particular the conservation and tourism potential of the dam and its catchment, need consideration.

It can be argued that Fiji makes relatively good use of biomass energy, the two largest producers of waste 'FSC and Tropik Wood' both use the waste to produce power. Similarly FFI's Waivunu Sawmill now under construction also proposes to burn mill waste to produce power. In the rest of the sawmilling industry, however, wood waste accumulates and disposal methods leave much to be desired. Fiji also has responsibilities to the international community to reduce emissions of 'greenhouse' gases, thus energy production by burning wood wastes or bagasse needs to be examined in this context.

4.10 MANUFACTURING

Recent performance of the manufacturing sector

Table 21 summarises the recent movements in the industrial production index. The quantity of manufacturing output declined in 1987 and 1988, then recovered in 1989 and 1990. This recovery was led by strong growth in the newly-established garment industry.

The sector has become one of the fastest growing sectors in the economy in terms of employment generation, with 23.6% of total paid employment in 1990.

Environmental management and planning implications

Current operations and developments within the manufacturing sector do not have adverse environmental implications. However, any increase in the manufacturing sector can be expected to increase the urban and peri-urban populations. Such increases are in themselves undesirable, but it is these locations where environmental issues of social concern are already deteriorating, in particular housing, sewerage and sanitation and waste disposal. Unless greater resources are diverted to rectifying these existing deficiencies further deterioration can be expected.

It is considered unlikely that 'high pollution risk' industries - heavy industry, advanced electronic technology etc. will be greatly attracted to setting up operations in Fiji. This is fortunate, however, the diversity of industry will clearly expand, further taxing the current inadequate pollution control. Even seemingly innocuous industries can be potential polluters for example textiles with dyes and paint manufacturers with solvents, etc.

New industries will require new industrial complexes and the current steady erosion of prime agricultural land to other uses may be accelerated. Alternatively there may be fresh calls for further reclamation of mangroves and coastal areas. Neither of these are desired and will require careful consideration and policy directives.

4.11 WASTE AND POLLUTION

Industrial Waste

Industrial activities in Fiji are varied and quite robust for a small country in an isolated location. Because of the absence of direct regulations controlling water or air pollution and the consequent lack of monitoring, there is a serious lack of data on the types and extent of pollution present in the country, in particular industrial pollution.

Tourism

Tourism is Fiji's largest industry and was estimated to have generated \$350 million in 1990 (Chapter 12). The wastes from the tourism industry are primarily sewage from the guests, restaurants, and staff. Since most hotels and resorts rely upon water and beach quality, they have a self-interest in maintaining the quality of their surrounding environment. Sewage treatment systems at the main hotels are usually quite sophisticated and well-run, with sewage often undergoing primary and secondary treatment. Smaller tourist facilities have septic tank systems, which are usually adequate for the number of people served; but expansion of such facilities has in some cases involved an undesirable density of such tanks.

. Sugar industry

This is the second largest industry in Fiji, generating approximately \$300 million in total revenue, through the production of 470,000 tonnes of sugar. Approximately 700 square kilometers of land is used in growing sugar cane in Fiji. Loss of soil from marginal cane lands apart, the chief environmental hazards of the cane fields are the 'inputs' used, fertilizer and pesticides. The mature sugar cane is crushed at one of four mills in Fiji: Lautoka, Rarawai, Labasa and Penang. About 8-9 tonnes of cane are crushed to produce 1 tonne of sugar. The crush waste, bagasse, is used as fuel at the mills. Effluent from the mills is primarily cane wash water which contains soil and sugar, and waste waters from washing equipment, which may contain caustic soda. Settling ponds are used by the mills. Poisoning of fish, in the Ba River in particular, has been blamed on caustic soda leakage from sugar mills. Solid waste (mill mud and mill ash) contains lime, nitrate and phosphate. Prolonged storage of these materials in a moist condition produces unpleasant odours, a practice which has evoked strong criticisms from neighbouring residents.

. Sawmilling

By far the largest sawmill in the country is the Tropik Wood saw mill at Drasa, near Lautoka. This modern facility processed 316,500 tonnes of logs in 1990. Seventy percent of the logs are chipped for sale to Japan, and the remaining 30% are turned into timber. In terms of solid waste, the sawmill produces about 14,000 tons of wood waste a year, which accumulates in a rubbish tip that is continuously smoking from spontaneous combustion. Some chemical waste containing copper, chromium and arsenic is generated by the treatment plant that treated 14,600 tons of timber with wood preservatives in 1990. (There are 19 other treatment plants in the country, each generating some copper, chromium and arsenic wastes). Air pollution is generated by the burning of sawdust waste in the boiler to produce electricity. Water pollution is generated primarily through run-off from the sawmill site carrying copper, chromium, and arsenic from the treatment of the wood.

. Power generation

All of Viti Levu's power requirements are now met through the Monosavu Dam project, which has resulted in the closing of many diesel powered generation plants, a significant economic and environmental benefit. The other islands in the Fiji group rely upon diesel generators which generate air pollution and noise. However, population is sparse on the other islands, so no serious air pollution occurs.

. Fish Processing

Fiji's major cannery is the PAFCO plant at Levuka. It is 99% owned by the Fijian government, and generated about \$50 million in sales in 1990. The plant processes approximately 15,000 tonnes of tuna a year. Fish wastes are collected and turned into fish meal. Wastes from the fish meal plant, and from the various steps in the processing of fish are discharged directly into the sea, and it is this water pollution that is the primary environmental consequence of the cannery. The wastes are high in organic content and cause an area of high turbidity that can reach out as far as the reef and out through the passage in the reef. The effluent is not toxic, and does not appear to cause oxygen depletion in the lagoon, other than perhaps immediately adjacent to the plant for short periods. Human wastes from the work force of 800-1000 people go into a septic field that is clearly overloaded and seeps into the sea. PAFCO is currently undergoing a \$10 million expansion which includes the construction of an outfall extending through the gap in the reef and discharging at a depth of 200 m. Once this outfall is built the water pollution problem is expected to be much reduced or eliminated.

Solid waste from the plant is primarily tin from the tin manufacturing plant. Waste tin is accumulating on PAFCO land adjacent to the plant and will eventually have to be dealt with. There are no real smokestacks emitting air pollution, but the smell, especially from the fish meal plant where fish wastes are dried, can be very strong.

A noxious smell emanating from Fiji's other fish canery, Voko Industries at Laucala Beach is a major complaint. Fish wastes in suspension are not treated before disposal and there is no monitoring of the plant's effluent.

. Mining

There is only one active mine in Fiji at the present time, the Emperor mine at Vatukoula. This is discussed in Chapter 4.7 - Mining.

. Industrial Areas

Some areas, such as Lami, Walu Bay, Vatuwaqa and Laucala Beach Estate around Suva, have a collection of smaller industries (bottling plants, food processing plants, paint manufacture, machine shops, furniture plants, petroleum storage, garment manufacture) that produce wastes, particularly liquid wastes, that discharge into coastal lagoons with limited water exchange. The water pollution from these areas significantly reduces water quality in the near shore waters around Suva and Lautoka. There are no effective regulations to control the profusion of sources of water pollution in these industrial estates, and the streams and creeks that drain these areas are probably the most polluted in the country.

Blatant dumping of pollutants and sometime hazardous material are commonly seen in these localities. Some, such as the illegal reclamation of foreshore using discarded vehicle batteries in Walu Bay, will be serious point discharges of heavy metals for centuries to come, if they are not controlled.

. Wastewater and sewerage

Despite major improvements in sewage treatment and disposal, about 40% of Fiji's population lacks proper sanitation facilities.

In urban areas 61% of the approximately 50,000 dwellings have a flush toilet in which wastes are either retained in septic tanks or discharged into the local sewerage system. In the rural areas, only 12% of 74,519 dwellings have flush toilets. The primary concern with sewage wastes is disease caused by pathogenic bacteria in human faeces. Cholera is one disease which results from poor sanitation. A second problem with sewage waste is that the high concentrations of nutrients can cause algal booms that are destructive to the ecology of receiving waters.

In Fiji the main problems occur in urban areas that are not sewered. Much of the Suva area, for instance, is located on 'marl' which does not allow septic tank effluents to percolate properly. In addition, the high annual rainfall (more than 3000mm annual average) and low evaporation (1300 mm annual average) results in frequent saturation which tends to prevent oxygen penetration. This leads to slow and inefficient natural treatment from the city's septic tanks. Combined they result in very widespread seepage of sewage waste into Suva's numerous creeks.

Rapid urban growth has outstripped planning and development resulting in inadequate sewage treatment capacities for nearly all the urban centres Table 21.

Also included in Table 4.7 is information on where the treated wastes are discharged. For Suva, in addition to the Vatuwaga River discharge and the Kinoya outfall, there are sewage effluent discharges into the Wailada Creek at Lami and the Leveti Creek at Nasova. A monthly system of monitoring for bacterial concentrations in the vicinity of the major outfalls is carried out by the National Water Quality Laboratory, which is located at the Kinoya Sewage Treatment Plant. However, this data is not released to the public and is not available for determining the status of the environment or the trends which are occurring.

Solid waste management

Garbage dumps

Virtually all of the urban areas in Fiji have problems with their solid waste disposal sites. The most pressing problem is the Suva City dump. The smell pervades Delainavesi and the main road into Suva, and the water leaching from the dump carries pollutants directly into the sea in an area heavily used for recreational and fishing purposes.

The Suva City dump has exceeded normal capacity limits and is now merely increasing in height. The search for an alternate site has been long, tortuous and to date unsuccessful. It is clear that if the dump had in the past been managed to acceptable standards, the reaction to having a new site anywhere in the vicinity would not be as vehement as it currently is, which would help in finding a new site.

Another example of poor waste management is the Nausori dump on the bank of the Rewa. The dump which is upstream from the town pollutes the river, is susceptible to being washed away in floods, and is an eyesore.

A characteristic of all but two municipal dumps in Fiji is their location in former mangrove habitats. This is not a result of being unable to secure other sites, but mangrove areas being State land do not have to be negotiated for or involve the payment of lease rent. Their use is merely a financial and expediency measure. Mangrove areas are totally unsuitable for garbage dumps unless seepage of pollutants can be contained by lining and bunding the whole area with an impervious material. No municipal garbage dump in Fiji is managed to accepted international standards, despite claims to the contrary and none could be described as a 'sanitary landfill'. Open dumping and burning is the most fitting general description.

There are also social issues involved, 'scavenging' is becoming prevalent at some dumps (for example Lautoka) and this is a grave risk to health.

It is clear that refuse disposal and the management of garbage dumps is a national dilemma which requires a firm government initiative. Alternatively municipal authorities require decentralisation of power from the central Board of Health, giving them the power to set fees, enforce payment, and level fines.

. Litter

Awareness of litter is at a relatively low level in Fiji: for example, after public events the amount of litter is enormous. Public areas are seriously underserved with garbage cans. Litter is routinely thrown onto the foreshore and into rivers and mangroves. Regulations defining litter and controlling its disposal have just been introduced by the Government.

In rural areas, villages tend to be well kept and clean, but coastal and river-front villages often dispose of their waste by throwing it in the water. Although this may be a perfectly effective method of dealing with food wastes, it is not a suitable method of disposal for modern garbage, with its high quantities of metal, plastic and glass.

The problem of littering cannot be solved by legislation alone. Public education is required to increase awareness of litter and to change behaviour patterns. Coastal villages in particular need to be advised of better methods of disposal than dumping in the sea. The tourism poster that reads 'Fiji - the World as It Should Be' will become an empty boast if Fiji is perceived as a place where beaches are fouled with garbage and litter.

. Recycling waste

With the exception of beer and soft drink bottles, there is no significant recycling of waste in Fiji. The major reason given for the lack of recycling and resource recovery is the insufficient quantity and the dispersed distribution of the waste which does not make it an economically viable proposition to invest in a recycling plant.

Such considerations do not usually include the cost saving to the municipal authorities concerned in the reduction of volume to be collected and disposed of. Clearly government or municipal authorities should offer economically justifiable incentives to attract such investment.

. Air and noise pollution

Because of relatively rapid urbanisation in Fiji, industries and vehicles are increasing faster than the controlling agencies are able to maintain control. In consequence the pollution situation is deteriorating. Apart from increasing cases of manifest abuse (e.g. Fiji Industries Cement Factory at Lami) background levels are also strongly suspected to be increasing but in the absence of regular monitoring this cannot be verified.

Principal atmospheric pollution from stationary sources in Fiji are:

- . Dust from quarries, asphalt plants, cement mills, stone crushers, furniture making and road dust from vehicles.
- . Odour nuisances from fish canneries, slaughter houses, sewage treatment plants, edible oil refineries, beer factories, soap factories and garbage disposal sites.
- . Poisonous gas and fume emission from diesel buses and lorries, petrol driven vehicles, the Gold Mine, asphalt plants, etc. and soot and smoke from sugar mill,

There is no regular monitoring of air pollution undertaken and even data from spot-checks is fragmentary. The latter indicate background levels of dust and particulates (Figure 21) can be high in certain locations such as the Suva Bus Terminal, but these levels and those of gas pollutants (carbon monoxide, nitrogen dioxide, sulphur dioxide, ozone and hydrogen sulphide) do not appear to be found in concentrations likely to result in adverse health affects, at the present time.

Noise pollution in Fiji includes the following sources:

- . industrial processes;
- . vehicles;
- . recreation venues (eg. night clubs);
- . dogs barking; and
- . from residential premises (eg. motor mowers).

As with air pollution, no monitoring of noise levels is undertaken. Spot checks indicate that Suva is a very noisy city where background noise levels are above the 'acceptable limit' and in many cases above the extreme limits, almost irrespective of location.

Pesticides

Usage

Fiji imports approximately F\$1,900,000 worth of pesticides annually, (see Table 23).

While the total figures in Table 4.8 may be correct, the accuracy with which the products have been categorised is in doubt. Importers and retailers estimate that herbicides make up approximately 75% by volume and 55% by value of all pesticides sold.

Fiji's Pesticide Register lists about 600 products based on about 95 active ingredients. However, many of these products and active ingredients are now no longer in use or offered for sale. There is no legal requirement that such products be removed from the register but efforts are being made to do this. Also, several products have had their registration cancelled after new evidence of possible harmful side effects became available. For example, the herbicide 2,4,5.T and most of the chlorinated hydrocarbon insecticides (e.g., Dieldrin and Aldrin). Commonly used pesticides are listed in Table 24.

A range of household insecticides are retailed throughout Fiji; the main active ingredients are propoxur, pyrethrins and pyrethroids. None give cause for concern in normal use.

Pesticides are also used by pest control companies and public health officials to control rats, disease vectors and nuisance insects. The main active ingredients in use are brodifacoum,

bromadiolone, diazinon, difenacoum, dphenothrin, malathion and propoxur, all are in the moderate to slightly hazardous categories.

Fumigants are only applied by trained plant quarantine and pest control company officials. Only three are commonly in use, these are ethylene dibromide, methyl bromide and phosphine.

No regulations exist to specifically control how pesticides are used on farms and other work places. However, commercial pest control operators may come under the Factories Act.

. Supply

Several companies import ready formulated pesticides and these companies are also the main retailers. One company, Agchem Ltd, is able to formulate products; these are 2,4.D, carbaryl, diazinon, dimethoate, diuron, malathion, MCPA, MSMA, naled, paraquat and propanil. This company also does some repackaging.

Large agricultural concerns and pest control companies are permitted to import products they have registered themselves for their own specialised uses. These are used by their own staff and are not for sale.

Products are predominantly sourced from major international chemical companies in Australia, Japan, New Zealand and the USA; these include: BASF, Bayer, ICI, M&B and Monsanto. A few are also supplied by an Australian based formulator, NuFarm, and an Israeli company Makhteeshim Hagan. However, some products and active ingredients are also obtained from less well known sources in S.E. Asia and Taiwan, in particular, acephate and paraquat.

Imported products and active ingredients are not checked for quality and composition, neither are the products that are formulated locally. Indeed the legislation in this area has never been adequately tested as the only known case (against supposedly sub-standard MIPC) was settled out of court and the product withdrawn.

. Legislation

The Pesticides Act of 1971 regulates the use and sale of pesticides through the Pesticide Regulations 1971.

The Act prohibits the use or sale of pesticides in Fiji unless they have been registered with the Registrar. The Deputy Permanent Secretary (Services) MPI&C is gazetted as the Registrar.

The Registrar is empowered to:

- . register a pesticide with or without conditions;
- . refuse registration, with reasons if requested;
- . require label changes on registered products;
- . cancel registrations with 6 months notice (subject to appeal).

The Act requires that all changes to the label, containers and formulation must be approved by the Registrar. It also empowers the Minister to make regulations to control the use and sale of pesticides.

The Regulations specify the types of data to be submitted in support of registration and the details to be incorporated into the product label. In particular, information on safe use, storage and first aid should be written in English, Fijian and Hindustani.

All pesticides intended for use against pests of the major crops are tested in-country through two growing seasons before they are registered. This is done by Government research officers, often with the assistance of the chemical companies, and enables them to issue country specific recommendations for use.

Applications for registration and, where appropriate, the results of in-country testing, are collated by the Registration Officer before being circulated to an unofficial Pesticides Committee for comment. The Registrar then decides whether to register the product or not and what conditions to attach to the registration. The Committee consists of the Director of Preventive Medicine and the Chief Pharmacist from the Medical Department, and nine senior officers of MPI&C. Comments are rarely sought from dealers, users or environmental protection officials.

Under the Pesticides Act any change in formulation or even source of the active ingredient, needs the approval of the Registrar. However, to check on this would require local analytical services, permanent government inspectors and increased vigilance on the part of the Customs Service.

The lack of checks on quality and the low level of import surveillance exposes Fiji to the threat of 'dumping' of large quantities of low quality products or those which are banned or restricted elsewhere. The two most significant areas open to abuse are:

- . the lack of checks on the importation of active ingredients to ensure they have been obtained from the registered manufacturer;
- . 'piggyback' registrations - where different formulations of previously registered products are registered with much reduced scrutiny.

ping' of pesticides in Fiji, however, is unlikely to be a significant problem because:

the most commonly used pesticides are not banned or severely restricted elsewhere;
most products and active ingredients are sourced from reputable international companies;
Fiji companies do not usually hold large stocks due to the expense of so doing; and
the market is very small.

recent pesticide sector review, made several recommendations:

the formal establishment of a Pesticides Committee;
the formal appointment of Inspectors;
the licensing of distributors and dealers;
the improvement of analytical facilities;
improved liaison with Customs;
training of the Registration Officer.

It is noted that from some training for the Registration Officer none of the recommendations have been carried out.

The review concluded that while the present system is registered satisfactorily, it is fortunate that most products are sourced from reputable companies in countries where their safety, environmental impact and bioefficiency have already been evaluated.

Some of the recommendations require legislative action and require Government financial resources. However, two could be implemented now at little cost:

The composition of the unofficial Pesticide Committee could be changed, at no cost. The inclusion of representatives from the Government Environmental Management Committee and users or importers would assist the committee and ensure the concerns of these groups were heard.

Liaison with Customs could be improved. Officers could be provided with regularly updated lists of registered pesticides, including such details as the name of the manufacturer of the active ingredient, and the registered importer.

Accidents with pesticides

Several cases of pesticide poisoning are reported each year in Fiji. Most occur through the deliberate misuse of the product, ranging from the use of pesticides for fish poisoning, to suicide attempts. Undoubtedly, some environmental pollution also occurs from run off and the incorrect washing of equipment and disposal of unused pesticides. All these stem from a lack of knowledge and care in use. Enhanced retailer

Policy objective: 'to protect and develop natural vegetation where its retention is necessary for climatic reasons and for the conservation of resources of soil and water necessary for good agriculture and to ensure adequate and continuous supplies of forest produce'.

'With tourism becoming an important industry the amenities provided by forests and trees should be developed as a tourist attraction, as well as catering for the local population'.

Fisheries

'Marine pollution is becoming a serious problem and one of increasing concern with regard to its effect on fisheries resources. It is intended to study the effects of pollutants discharged from ships, the disposal of noxious chemicals, sewage, rubbish and other urban and industrial wastes'.

DP7 (1976-80)

In terms of national environmental policy DP7 is a milestone. A specific chapter, 'Development and the Environment', was included in the plan's overall statement on national development objectives and strategies, prior to the chapters on individual sectoral plans. This was the first and last time that a broad overview approach was taken to the national environment in the preparation of development plans.

The development plan stated that:

'Economic development which is undertaken in accordance with ecological principles, paying due respect to the need to plan resource exploitation carefully and to limit the dispersal of wastes in the environment, is better development. In some cases, in simple economic terms, it may initially cost more. In the long term the economic, social and environmental benefits will far outweigh these initial costs. Only an ecological approach to development now will enable us to hand on to future generations a carefully managed, relatively unpolluted land with adequate and comparatively undamaged natural resources.

During the Plan period, Government's fundamental goal will be to exploit Fiji's natural resources wisely, in a manner which is consistent with the maintenance of a healthy environment and with the generation of benefits for all of the people, today and in the future'.

In order to achieve this goal DP7 presented the following objectives:

coastal development proposals will be carefully evaluated with a view to balancing environmental costs against expected development gains;

- . public access to beaches will continue to be promoted;
- . soil erosion, a serious constraint on development, will be curbed; appropriate soil conservation techniques will be required for all development projects;
- . mineral exploration and mining will be permitted only in the context of strict environmental safeguards;
- . development technologies which produce less waste will be encouraged, stringent standards will be insisted upon for effluent quality and outfall locations;
- . existing legislation to restrict sales of dangerous pesticides will be effectively enforced;
- . encouragement will be given to the development of indigenous nonpolluting sources of energy;
- . action will be taken against excessive noise;
- . more national parks and reserves for study, recreation, species protection, tourism and landscape protection will be established;
- . environmental education will be vigorously promoted through schools and among the public;
- . a comprehensive national environmental policy will be prepared as a basis for administrative and legislative developments in this area, a key feature will be a requirement for advanced environmental impact studies of development projects where such impacts are liable to have a significant effect.

In a concluding discussion on policy, administration and legislation the chapter forecast the development of an environmental administration structure to link 'various Ministries whose activities bear on the environment'. It also stated that an advisory Fiji Environment Council would be established.

The DP7 environment goal and objectives represented an impressive ledger of achievements, if implemented. However, most of the more significant issues are still unresolved or inadequately dealt with today. By the end of the development plan period the only significant achievement was the establishment of the Environmental Management Committee in 1980. It is notable that no budgetary provision was allocated for implementation of the objectives.

Brief environmental considerations were noted in the sectoral plans for Forestry, Tourism, Mining, Lands and Energy. Those for the last two are of interest:

- . **Lands**
'.. considerable emphasis will be placed on ensuring that land reclamation does not adversely effect the ecology of the area or unduly interfere with the natural river regime' (This statement follows a discussion of major mangrove reclamation projects during DP6, including 380 hectares at Raviravi which DP7 predicted would be under cane by 1976 - although the area is still an unproductive wasteland in 1991).

Energy

'In future all energy development schemes will be subject to scrutiny of their environmental impact'. (It is notable that neither Monosavu or Vaturu Dams had comprehensive environmental impact assessments undertaken subsequent to the formulation of this policy objective).

DP 8 (1981-85)

Following the inclusion of 'environment' in the overall development strategy of DP7, the placement of environment in DP8 represents a significant drop in status, as it was placed within the Social and Community Development Sector. Not only was the environment sectorised but it was included within the category 'Leisure, Recreation and the Environment'. Accordingly, the main emphasis of the discussion on environment relates to amenity values (parks and reserves for recreation).

However, the plan reaffirmed that the objectives of DP7 still applied to the DP8 period. In assessing progress during DP7, it was acknowledged that the operation of the National Trust was 'hampered by limitations on resources and trained staff' - a situation which remains unchanged in 1991. With regard to progress, the plan stated that an inter-ministerial Environmental Management Committee was established as 'the main forum within Government through which environmental concerns, research priorities and coordination will be discussed'. The plan also forecast that an Environmental Unit would be established within the Department of Town and Country Planning to implement policies. However, this did not become a reality until 1989.

The plan also stated that a National Parks and Reserves Act would be enacted which would "effectively provide for the preservation and protection of the natural environment including unspoilt landscape, reefs and waters, indigenous flora and fauna, habitats and ecological systems, features of scenic, historic or archaeological interest or other scientific interest". Such legislation still remains to be enacted. DP8 was the first plan to specify budgetary allocation for environmental concerns, with an annual budget of \$90,000 indicated for the National Trust. However, an annual allocation of that sum has never been provided to the Trust, it has always been considerably less.

With respect to other sectoral planning the following objectives are of particular interest:

Forestry

'..... it is very important to ensure the long term continuity of supply of native timber. There is a need to preserve an adequate area of natural forest to produce those species of timber, which for the most part are not amenable to plantation production. Equally there is a

need for forest preservation against soil erosion as well as for amenity and recreation purposes'.

Mining

The plan identified a specific project for evaluation of the environmental effects of mining operations. It further stated that: 'Government shall require an environmental impact study (EIS) to be undertaken for any mineral development project...(It) will be specified as a condition of every mineral or oil exploration licence'.

Transport

'Regulations concerning environmental pollution, safety and road use will be strictly enforced

DP 9 (1986-90)

This development plan repeated the format established in DP8 by including 'Environment' in the Social and Community Development Sector. However, its scope was somewhat wider than the previous plan stating:

'Maintenance of Fiji's healthy environment through protection and conservation of its unique features, and the judicious utilization of its resources form an integral part of development'.

It is also recognised that:

'A number of environmental problems continue to affect Fiji. These are mainly associated with natural resources and indiscriminate development in agriculture, industry and infrastructure. Continuation of this trend would result in further deforestation, mangrove destruction, soil erosion, and pollution of coast and rivers. In addition, increasing development pressure in both the urban and rural environment has been reflected in the degradation and deterioration of Fiji's archaeological, historic and architectural heritage.

Soil erosion is considered to be the most serious environmental problem in areas of steep land cultivation, due to over-grazing or over-stocking, uncontrolled burning of grassland and cane trash, steep land logging, construction of new roads, land excavation for subdivision, and uncontrolled bush clearing for cultivation.

There is a need for an effective institutional framework within Government to be responsible for overall co-ordination, planning and management of environmental matters'.

During the plan period the stated objectives for environmental management were:

- . protect and conserve unique features of Fiji's environment;
- . ensure that environmental assessments are incorporated into programmes and projects;
- . set up machinery to initiate, integrate and implement environmental policies; and
- . strengthen environmental education.

In order to achieve those objectives the plan identified the following programmes:

- . establishment of an Environment Unit within the Department of Town and Country Planning to achieve 'better co-ordination, effective formulation and implementation of national environmental policies';
- . developers would be required to submit an EIA for projects 'to arrive that development activities are in harmony with environmental policies';
- . laws which have hitherto not been co-ordinated (would) be brought together and new laws enacted to cover all aspects of environmental management; and
- . public environmental awareness would be improved.

In order to implement these objectives and programs DP9 presented on ambitious "indicative" expenditure program for both the Environment Management Committee (EMC) and the National Trust. However, such expenditure levels were never implemented and, apart from minimal budgetary allocation for the Trust, the provision of funding for the EMC and Environment Unit has never eventuated (except for employment of one staff). With respect to the programs, the Environment Unit was established and application of EIA procedures has improved considerably. However, the review of environmental legislation did not take place and implementation of public awareness programs has been minimal.

Environmental considerations of note in other sectoral planning include:

- . **Agriculture**
To carry out sector objectives 'within accepted soil conservation and environmental parameters'.

An acknowledgement of lower sugar production levels based on cane to sugar ratio and lower farm productivity. Although not stated, this is likely to be a result of declining soil fertility.

With respect to the ginger industry the plan acknowledged that 'soil erosion and the adverse effects on the environment under present methods of production' was a constraint.

Forestry

'Ensure sound forest management and land conservation practices so that forest resources are further developed and maintained in perpetuity'.

A commitment was made to expanding the system of forest nature reserves and recreation areas.

Mining

A commitment to safeguard the environment and improve pollution monitoring.

Tourism

For the first time in a development plan this sector acknowledged the role of national parks in tourism.

Water supply and sewerage

A commitment to finalise and enact a Water Resources Act. This was also a commitment in DP7 and DP8. It has yet to occur.

5.2 Recent policies and strategies

'Policies and strategies for the short and medium term', National Economic Summit 1989

The environmental policy strategies contained in this document reflect more of the broader environment development relationships identified in DP7, although the environment was still 'sectorised' within the Social and Community Development sector. The report presented the environment-development overview as:

'Environment issues have become increasingly important as manufacturing activities develop and agriculture becomes dependent on a more intensive exploitation of land. Increasing consideration has to be given to competing uses of land for industry, tourism, settlement, agriculture, and mineral resources exploitation. The quality and productivity of water resources, inland as well as for estuary, lagoon and reef ecosystems, are becoming endangered by increases in polluting discharges. Water catchments are subject to siltation through deforestation and other poor land use practices.

Effective support for environmental planning and management at this stage of the development process is likely to yield high economic benefits through savings on

much higher future costs for clean-up and regeneration. Preventive strategies are considered the most cost-effective.

The policy is to integrate environmental management into the planning and development process in order to safeguard the environment and its regenerative capacity while improving economic productivity of resources. A key to success is a comprehensive effort by all relevant ministries and their involvement in the formulation and implementation of a comprehensive national environment strategy. Environmental concerns and requirements must be internalised through each department, in programme and project preparation, and in implementation'.

After almost 20 years of post-Independence development planning the links between environmentally sustainable development and long term economic benefits were fully expressed in national development policy (apart from economic references in DP7). Another important aspect was recognition of the need for a multi-sectoral approach in the implementation of environmental planning and management strategies. Other specific issues and initiatives identified in the report included the preparation of the National Environment Strategy (then in its project planning stage), the need for improved legislation, a national physical development plan, national parks and reserves; and the need to plan for climatic change.

The report was notable for the relatively detailed presentation of key environment policies/strategies in different sectors. Specifically: agriculture (scarcity of arable land, need for watershed management, and development of MPI-Environment Unit interaction on land use and environment issues); fisheries (preparation of a Marine Environment Management Plan); forestry (land conservation issues, establishment of a Trust Fund for landowner compensation); Mining (EIA implementation); tourism (role of environment in development of secondary tourism and landowner participation) and manufacturing and commerce (need for strict standards of environmental protection in development of industrial infrastructure).

'Review of performance and prospects - Fiji economy', National Economic Summit 1991

This review has largely reproduced the sentiments of the 1989 report. One important difference was the inclusion of the following statement on environmental policy in Chapter 3 - 'Economic Policies and Strategies':

'Many countries have found that apparently rapid economic growth has been achieved only at the cost of a serious depletion of both renewable and non-renewable assets and to the detriment of their living environment. It is recognised that measures have to be taken early to

prevent these hidden and often inadequately accounted costs

The objective is to promote sustainable development, incorporating a framework of project design, approval and monitoring that ensures the prevention of adverse environmental effects'.

Within the forestry sector review it is acknowledged that 'the sector needs to be developed in a sustainable manner which does not damage the environment'. Additionally, by way of support, it is stated that international lobbies for rainforest conservation are already affecting the trade in tropical timber.

5.3 International conventions and interaction

Fiji has actively participated in international conventions and treaties related to the environment for many decades. It has become party to the:

- . International Plant Protection Convention (1956);
- . Treaty Banning Nuclear Weapon Tests in the Atmosphere, Outer Space and Underwater (1972);
- . Treaty on the Non-proliferation of Nuclear Weapons (1972);
- . Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological and Toxic Weapons and their Destruction (1973);
- . South Pacific Forum Fisheries Agency Convention (1979);
- . South Pacific Nuclear Free Zone Treaty and Protocols (1985);
- . Vienna Convention and Montreal Protocol on Substances that Deplete the Ozone Layer (1989);
- . Convention on the Conservation of Nature in the South Pacific or Apia Convention (1989);
- . Convention for the Protection of Natural Resources and Environment of the South Pacific and Related Protocols or SPREP Convention (1989); and
- . Convention Concerning the Protection of the World Cultural and Natural Heritage or World Heritage Convention (1990).

Most of these conventions and treaties place a legal commitment on Fiji to adhere and apply their various articles at both national and international levels. With respect to the Montreal Protocol, the Government is already taking action to phase out the use of chlorofluorocarbons (CFCs) by the specified dates. Fiji's obligations under the Apia Convention to adequately conserve representative ecosystems and to implement effective environmental management procedures under the SPREP Convention have yet to be met, although the outcome of the National Environment Management Project (if implemented) will address these requirements. The recent establishment of the National Oil Pollution Committee and development of a national oil pollution contingency plan will

also meet some of the anti-pollution requirements of the convention and its protocols.

Fiji also undertakes an active role in regional and some international environmental issues. The country has participated in the South Pacific Regional Environment Programme since 1983 and maintains a relatively high profile on regional environmental issues. On the wider international scene Fiji has participated in environmental meetings and conferences on the Asia-Pacific region organised by ESCAP in Bangkok. It is also participating in preparations for the UN Conference on Environment and Development (UNCED) in Brazil in June, 1992 and participating in activities relating to global climate change issues, including the development of a convention on climate change to be adopted at UNCED.

Also at the international level, Fiji's involvement with bilateral and multilateral aid donors and lenders has also had an effect on its national environmental management activities. Most, if not all, of these donors and lenders now require environmental assessments of proposed projects as a condition of granting aid or loans for development.

6. ENVIRONMENTAL LAWS AND ADMINISTRATION

6.1 Overview

Fiji's environmental laws are many and varied, a relic of the colonial period when environmental problems were limited and clearly sectoral. At least 25 Acts have some important role in what is today perceived as environmental management, and they are administered by at least 14 different ministries, statutory bodies or other agencies. Most of the laws are old and ineffective in a modern environmental management context or suffer from lack of enforcement of regulations through inadequate staffing, lack of technical resources and funding, or through administrative failures.

An annotated list of these laws is provided in Table 25. What is immediately apparent from the table are the insignificant penalties which can be imposed. Even the 1990 Ports Authority of Fiji Regulations provide for a maximum fine of only \$400, a chemical spill in Suva harbour would cost the Government perhaps millions of dollars to clean up.

Currently it is the Town Planning Act which provides the mechanism for environmental impact procedures. Under the Act the Director of Town and Country Planning can impose such (pre)conditions on proposed developments as he believes appropriate or necessary under the circumstances. It is through the application of conditions to private and some public sector development approvals that requirements for environmental impact assessments (EIAs) are imposed. Tourism development proposals comprise the majority of EIA conditions imposed under the Act. The General Provisions (1980) of the Act also provide for a building setback of 30 metres above high watermark to allow for public access to the foreshore.

Land and water below the high water mark is the property of the State and is administered by the Ministry for Lands and Mineral Resources through the Department of Lands and Surveys. The Director of Lands has the power to grant foreshore leases, which are usually sought for reclamation purposes, and licenses for dredging. A number of these applications frequently involve reclamation of mangrove or other sensitive areas. Applications are referred to the Director of Town and Country Planning for comments, recommendations and suggested conditions if approved. The Director of Lands also refers the application to the Department of Fisheries for assessment of the resource and to the Native Fisheries Commission for arbitration of compensation. In 1974 the Government set up a procedure to compensate traditional fishing rights owners for the loss of customary fishing rights/resources associated with the granting of foreshore leases and subsequent development, and dredging. This procedure for monetary compensation to traditional owners for loss of natural resource use has set a precedent which now has wider implications for some aspects of

environmental management, especially with regard to establishment of protected areas.

6.2 Laws of land and resource use

The principal legislation in this category are the Forests Act and Land Conservation and Improvement Acts of 1953, and the Mining Act of 1966.

While there are loopholes in both the Forests and Land Conservation and Improvement Acts, it is generally considered that both have ample legislative power to control many of the problems readily evidenced in the forestry and agricultural sectors. That they have not been used to this effect is clearly through lack of application by the ministries responsible.

As with all environmental legislation, its effectiveness ultimately depends on political resolve, which in this sector is to implement proper watershed management programmes. To date this resolve has been lacking, this is in spite of many reviews and studies on the subject.

A notable, positive move has been the recent revival of the Land Conservation Board after many years of inactivity. The Board has wide powers, however, its job is difficult as it will have to combat many years of farmer and institutional indifference to sound agricultural practice. If it pursues its mandate vigorously it will have to make difficult decisions which will clash with other national and ministerial objectives. Notable amongst these will be in the expanding ginger industry, which to a major extent is based on unsustainable farming practices.

One of the most disappointing lack of uses of appropriate legislation is that by the NLTB whose leases require the lessee 'to farm and manage the land in such a way as to preserve its fertility...' The NLTB as custodians of the land for future generations needs to ensure practice of sound agricultural management on its leases. The NLTB can be seen to be abrogating its responsibility if lessees are allowed to drain a lease of all its natural productivity and soil resources, before abandoning it and moving on to another new lease, as is reported to be almost commonplace in the ginger industry.

6.3 Laws of the marine environment

Fiji's marine environment is better served by laws and regulations than any other sector. The most recent to be passed, the Ports Authority of Fiji Regulations 1990 may help to clean up some of the blatant acts of pollution in Fiji's ports.

Of all the conservation laws, the fisheries regulations are publicly anyway, the most conscientiously enforced. Clamp downs on the sale of undersized produce and prosecution of users of dynamite, for example, are regularly reported. Nonetheless Fisheries Department personnel believe these efforts should be greatly increased but they lack the resources.

Some of the stiffest penalties are to be found in fisheries associated legislation. It is of interest to note that whilst a foreign fishing vessel fishing without a license in Fiji waters may be fined \$100,000 (large though it may seem it is small by comparison to the potential profits of some of the modern fishing boats), a foreign company running a polluting industry in Fiji, may with difficulty be prosecuted under the Public Health Act and fined a maximum of \$20.

6.4 Laws of conservation and quarantine

Traditionally, legislation worldwide to protect wildlife relied on listing the species to be protected while the remainder enjoyed no protection. Such legislation needs constant updating and changing as more and more species become threatened. Modern legislation takes the opposite approach, all species are protected except those specifically listed and many countries in the world are attempting to change to this approach. With remarkable foresight, Fiji adopted just this approach when it passed the Birds and Game Protection Act in 1923. It remains a remarkable piece of legislation under which, for instance, all native birds are completely protected (except certain pigeons in the 'season').

Unfortunately the reptiles were ignored and while the turtles are now afforded some protection under the Fisheries Act, the internationally renowned Crested Iguana has no legal protection.

For the conservation of historical artifacts of any nature the National Trust of Fiji Act and the Preservation of Archaeological and Palaeontological Interest Act have very wide powers and possibilities.

However, only one National Monument, Wasavulu near Labasa, has ever been declared. Recent moves by the Department of Town and Country Planning have initiated protection of historic buildings through planning regulations.

A Plant Quarantine Act was passed in 1982 to replace the Noxious Weeds, Pests and Diseases of Plants Act of 1964. The legislation controls, through a system of import permits, inspection and treatment, the importation of plants and anything that might harbour plant pests and diseases. The Animal Importations Act was passed in 1970 and all the regulations updated in 1985, the legislation strictly controls the importation of all animals and animal products into the country.

6.5 Laws of freshwater usage and its pollution

Legislation controlling freshwater usage - from rivers or streams dates back to the Rivers and Streams Ordinance of 1880 with only minor amendments. It has been the subject of several reviews and it is regarded as being full of ambiguities with the ownership of the rivers and the river beds vested in the Crown/State but nonetheless stating certain public rights. New legislation was drafted in 1976 but has yet to be passed. Fiji has no groundwater legislation or laws.

Sound water legislation is essential if any watershed management programmes are to be effectively implemented. While hitherto this has not been an issue of concern, modern requirements for water diversion or consumption are increasing rapidly, not just in number but in scale.

6.6 Laws of pollution

Pollution has many origins and the laws dealing with them in Fiji are perhaps the least effective of all the environmental laws. Prosecution of anyone causing pollution is almost practically impossible and has never been carried through. Thus, some of the most blatant offenders, such as the Fiji Industries cement factory at Lami, garage and bus owners dumping oil directly into drains etc. continue to operate effectively uncontrolled, despite many years of muted public concern.

Nonetheless offenders causing some of the most common and offensive (but not necessarily the most injurious to health) forms of pollution such as smoky vehicle exhausts could be prosecuted, given sufficient political directive.

Litter laws have recently been passed by cabinet.

All petrol sold in Fiji contains lead additives and there is no programme in place for gradual conversion to lead-free petrol.

In essence the only form of pollution control currently being exercised is not through legislation resulting in prosecution of offenders, but in the Government and Local Authority licensing and development consent of new industries and plants. Effectively this means that existing polluters continue unhindered although there are a few who have exercised some form of self-imposed control.

6.7 Administration of the environment functions within Government

Development of a specific environmental planning and management function has taken place within the Department of Town and Country Planning of the Ministry of Housing and Urban Development. An interministerial Environmental Management

Committee (EMC) has been operating since 1980. It was established with the aim of developing a co-ordinated cross-sectoral approach to environmental planning and management issues. However, the EMC has developed into a primary advisory and coordinating role with the main function of advising the Director of Town and Country Planning (who chairs the Committee) on the environmental implications of development proposals. Accordingly, one of the major tasks of the EMC is the assessment of environmental impact of development projects. A significant gap in current legislation relates to the fact that Government agencies do not have to comply with the statutory development approval process. However, the recent voluntary undertaking of EIAs and environmental reviews by the Ministry for Primary Industries for some of its projects is a notable, and encouraging, exception.

One of the primary objectives of the EMC is to provide advice to the Director of Town and Country Planning in the assessment of the EIAs. Not all EIAs are referred to the EMC given the increasingly large number of such reports being handled by the Department's Environmental Management Unit. However, 'significant' issues are referred to the EMC for advice. Notable examples include: the Tropik Woods timbermill - Drasa, Saweni Beach Resort, Denarau Island tourism development, Bua rice irrigation project, and so on. Unfortunately, the inadequacies of the present legislative and administrative system are highlighted by the inability of the EMC to control existing environmental problems, such as the Lami Cement Works pollution.

Other issues referred to the EMC include the activities of the South Pacific Regional Environment Programme (SPREP) as they relate to Fiji and the region. This includes: reports on intergovernmental meetings, review of the SPREP Action Plan, and review of bi-annual SPREP projects for Fiji. The EMC is also used as a forum for deciding appropriate representation to various conferences and training activities. During 1989-90 the EMC also played a major role in the development of the framework for the National Environment Strategy.

Representation on the EMC includes: MPI (Land Use, Drainage and Irrigation, Fisheries), Forestry, Lands and Mineral Resources, Health, NLTB, USP, Bureau of Meteorology, National Trust, and Museum. Representatives tend to be at senior technical level within the agencies.

In 1982 the Department of Town and Country Planning obtained approval to establish an Environmental Management Unit (EMU) to formalise the environment function within Government. It was not until 1987 that the Public Service Commission approved three positions for the Unit at principal, senior and officer level. However, the Unit was not staffed with principal environmental specialist until 1989. This principal position (occupied by an expatriate expert in the absence of suitable local expertise) is still the only professional position, and

the Unit has not received any budgetary allocation within the Ministry since its establishment. The main roles of the EMU can be summarised as:

- . providing a secretariat to the EMC;
- . acting as the South Pacific Regional Environment Programme national focal point;
- . developing national environmental policy;
- . coordinating environmental impact assessment of development projects;
- . developing environmental education and awareness programmes; and
- . providing project management to the National Environment Management Project.

In 1983 the Department of Lands and Surveys established an interministerial Mangrove Management Committee. The Committee meets on a 'needs basis' to consider proposals which affect the mangrove resources of the country, such as reclamation, dredging and timber felling. The MMC and the EMC collaborate in the evaluation of major development projects affecting mangroves, most recently in 1989 to evaluate the proposed dredging of 140 ha of mangroves in the Nadi River delta by EIE Corporation for the Denarau Island tourism development.

The Land Conservation Board has already been referred to in 19.2. In the last two years the number of ad hoc committees dealing with environmental issues has multiplied considerably (Annex 3).

The formation of these committees is, to a large extent, reflection of the sectoral nature of environmental responsibilities. It is also an indication of the growing recognition of environmental problems and issues. Although there is an obvious need for specific committees to resolve these issues or problems (and others will undoubtedly be required from time to time) there is a danger that without overall coordination that their formation will continue the country's compartmentalised approach to environmental management.

There is clearly a need to centrally coordinate national environment initiatives in an effective manner. Although the EMC originally had this task it has not proved effective, although it has operated well as a technical advisory committee on environmental management and development issues. The current National Environment Steering Committee has been established to provide this essential coordinating, policy level role for the important national and international environment initiatives of NEMP, UNCED and World Heritage. However, there are already indications that it will be viewed

as yet another ad hoc Ministry of Housing and Urban Development (and therefore largely sectoral) committee by other line ministries, which will tend to provide representation at senior technical level rather than policy/decision making level.

The answer may be the establishment of a Cabinet appointed National Environment Council, with high level public and (appropriate) private sector representation. Such a NEC would act as a coordinating and formulating interface between the range of sectoral activities with environmental implications undertaken by government and non-government agencies and Cabinet (and Parliament in the future). The major task of such a Council would be to develop a national, cross-sectoral approach to environmental planning and management, and free it from its current sectoral compartmentalisation.

6.8 Conclusion

One of the great ironies concerning laws and administration for the protection of the environment is that they are seldom if ever passed or set up before the resources they are designed to protect are already seriously depleted.

Laws do not automatically solve problems. While there is much scope for legal reform to promote environmental management, it will only be effective if there is better environmental education for the population as a whole, and firm direction on the part of the Government to ensure that laws are enforced.

In summary, the critical issues related to the present legal and administrative system are:

- . the use of old, ineffective laws;
- . uncoordinated and often 'half-hearted' approach to the application of laws which, despite shortcomings, could be used to enforce environmental standards;
- . lack of effective funding and technical resources, and trained staff to undertake environmental planning, management and enforcement;
- . poorly coordinated sectoral approaches to administration of environment related issues; and
- . of major concern, the non-applicability of existing legislation to Government agencies - compliance with environmental planning and management guidelines is voluntary, or coerced through environment conditions attached to develop aid funding or international loans.

7. Values and attitudes

7.1 Education

Fiji has achieved a high level of education provision. Access to education (over 98% for 6-11 year old children) is high by developing country standards. The quality of Fiji's education is reflected in adult literacy rate of 85%, one of the highest in the South Pacific and on a par with many middle income countries.

Environment education as a formal subject is not included in school curricula. There are two formal courses at the tertiary level, the University of the South Pacific offers an Environment Studies B.Sc. Degree and an Environmental Education Diploma.

7.2 Environmental awareness

Currently environmental awareness and concern in all communities in Fiji is at a very low level. Recently the Government of Fiji has made significant effort to initiate realistic environmental control and management with the establishment of an Environment Unit in the Department of Town and Country Planning, and the re-commissioning of the Land Conservation Board. However, effective control and management will require further direction and resources and will only be obtained if there is a corresponding rise in the level of awareness in the community at large. The National Trust for Fiji's Mobile Education Programme, undertaken between 1982 - 1988, has been discontinued.

7.3 Non-Government Organisations (NGOs) and Statutory Bodies

There are only two NGOs which operate on environmental issues, the South Pacific Action Committee on Human Ecology and the Environment (SPACHEE) - a University of the South Pacific based organisation sometimes regarded as being rather too academic and lacking in grassroot local membership. It nonetheless is the only active organisation and has a very wide resource base of expertise. While the other, the Fiji Council of Social Services has initiated environmental programmes in recent years but has yet to become established and active in the field.

The National Trust for Fiji, a statutory body, was set up by Ordinance in 1970, and as a statutory body but nonetheless with all the attributes of a NGO, it seemed well placed to be an effective catalyst for environmental awareness amongst other roles in environmental, physical, cultural and heritage conservation. In the event, the Trust has been a great disappointment as it has an unenviable record of lack of

achievement. Not only has it failed to win sufficient Government support but it has totally failed to initiate any form of successful fund raising in an international environment where such support is plentiful. Its abrogation of responsibility for management of the Garrick Memorial Park, a gift to the nation (see Box-8.1) resulted in the virtual loss of one of the most important conservation areas for tropical rainforest in Fiji without national or international censure.

As a result of general failure on the part of the National Trust, in recent years, other agencies and Departments have moved into areas of environmental protection and national and heritage conservation which formerly seemed destined for the National Trust. Thus the development of the Tavoro Forest Park and the Waikatakata Forest Park are being spearheaded by the Native Land Trust Board and Ministry of Forestry, the Tavuni Hill Fort by the Ministry of Tourism, while the environmental awareness programme for the National Environment Management Project is being undertaken by SPACHEE.

7.4 Social attitudes

In Fiji's multicultural society with its inherent imbalances and divergences in land ownership, economic involvement and cultural values, it is not surprising that there are wide divergences in environmental awareness and appreciation. However, it is clearly the Fijian landowners who will determine the efficacy of any initiative in sustainable resource use and environmental control.

Traditionally, Fiji's natural resources - the land and its forests, the rivers, coasts and sea were a major source of livelihood and security for landowners. Although this dependence on natural resources continues today, it has to a large extent changed its nature through the introduction of commercialisation and the economic imperative. This has affected the landowners close interdependent relationships with natural resources and their attitudes towards conserving them for their own use and for future generations. Traditional conservation and generally sustainable utilisation is tending to give way to active exploitation for cash revenue. Yet some of the most environmentally damaging practices such as the annual torching of grasslands, still continue. Wildfire remains the proximate cause of virtually all current deforestation.

It is a time of change with mixed views, emotions and perspectives. It seems inevitable that resource use is destined to become highly politicised.

Environmental awareness and sustainable resource use have much in common with traditional stewardship of communal lands, but the tangible constraints of environment management will nonetheless be viewed by many of the modern generation as

another form of exploitation of the landowners - this time by preventing them from utilising their natural heritage to their own advantage and at their own discretion. Far greater efforts will need to be directed to explaining the benefits of sustainable resource use to landowners, as a component of increased communal participation in the allocation of resource usage.

8 PROTECTED AREAS AND NATIONAL PARKS

8.1 Significance

While neighbouring Pacific nations such as Tonga, Vanuatu, Papua New Guinea, the Cook Islands and the Solomons have internationally recognised national parks, Fiji has none. In this aspect of development, Fiji far from being a leader in the Pacific, is demonstrably a laggard and this is particularly surprising when the link between Fiji's major industry, tourism, and national parks is so well known worldwide.

The reason for the absence of national parks or equivalent areas is in no way because of a lack of suitable sites.

Apart from the link with tourism, there is an obligation to the nation and future generations to preserve representative areas of original habitats, as well as examples of the cultural and constructed heritage. Fiji can also be seen to have an international responsibility to conserve representative areas of rain forest.

Unless a system of national parks and reserves or equivalent protected areas is accomplished quickly the forest resource is likely to become too fragmented and degraded for it to be conserved as viable ecological units.

Fiji faces a formidable problem in setting up a protected area system principally because it lacks all but a rudimentary system at present and one which was not selected on ecological grounds and whose legislative backing is insufficient to ensure long term security.

8.2 Existing reserves and protected areas

Sigatoka Sand Dunes National Park

In early 1988, the Cabinet of the Fiji Government decreed the Sigatoka Sand Dunes as Fiji's first National Park. An area of outstanding landscape and biological interest, the Sand Dunes also contain one of the most important archaeological sites in the Pacific, a burial ground of more than a 100 people dating back nearly 2000 years. Administration of the Park has been delegated to the National Trust for Fiji, but to date there has been no infrastructural development, and limited control of critical management issues such as grazing, firewood collection and sand removal. Without any form of management the Sigatoka Sand Dunes does not qualify under the international definition of a National Park.

Reserves of the Ministry of Forestry

Three reserve categories are institutionalised in the Forestry Act. In summary:

Nature Reserves

At present there are 6 nature reserves totalling 5,719 ha.

Protected Forest

At present there is a single protected forest at Batiwai.

Reserve Forest

There are 24 reserve forests totalling approximately 33,200 ha.

Together these reserves constitute approximately 5% of the native forest but the distribution between forest types and islands was unplanned.

The Ministry of Forests also recognises an additional management classification of relevance but which has no legal foundation:

Protection Forest

Following the original resource survey, approximately a third of the forest resource was designated as Protection Forest.

Although both the Ministry of Forestry and the NLTB support this designation, logging and clearance occurs very commonly in Protection Forests and it is clear that NLTB and MOF appear to have little ultimate control or ability to ensure its long, even medium, term protection.

Other protected areas

Several other categories of protected areas exist. Of major ecological significance are the Garrick Memorial Park (400 ha) which has been extensively logged and the Yadua Taba Wildlife Sanctuary (50 ha), set up to protect the world famous Crested Iguana. A management plan for the Garrick Park has been prepared but there is effectively no management. Yadua Taba has no management plan but a warden has been appointed and international funds have been acquired to assist in caretaker management. Both are administered by the National Trust for Fiji. Namenalala Island Reserve (43 ha) is leased by the NLTB to a private operator who runs the vast majority of the island as a nature reserve, and who is currently attempting to lease the reef surrounding the island in order to extend the nature reserve concept into the marine environment.

Of major significance is the recent opening of the Bouma Forest Park on Taveuni which is administered by the landowners with assistance from the Ministry of Forestry and bilateral

aid finance. It is an initiative, which if successful, has major positive implications for the conservation of native forests in Fiji. Additional recent initiatives of the same type but in an earlier stage of planning and development are the Tavuni Hill Fort in the Sigatoka Valley and the Waikatakata Forest and Archaeological Park on the Coral Coast.

Findings on the existing reserves and protected areas

The present system is seriously inadequate for the following reasons:

- . No ecological or heritage considerations were involved in the selection of all but one or two.
- . Protection forests given their present legal status and management have no long term conservation value.
- . Forest and Nature Reserves are departmental rather than national institutions. They have inadequate legislative and institutional support to counter the inevitable, political and social pressures which will increasingly involve them.
- . Dereservation of Reserves has increased in recent years and it needs only ministerial approval.
- . Without landowner approval and economic involvement, the present reserves on native land have no long term security. Even those on Crown Land will be subject to increasing piecemeal loss and degradation.
- . Planning and the limited attempts at implementation of reserve establishment are being undertaken by at least four different institutions with inadequate objectives and coordination.

8.3 Setting up a National Parks and Reserves system.

The National Trust for Fiji drew up a major report in 1980 which identifies a National Park and Reserve system. This is a significant contribution which identified the majority of the most important sites but there has been no implementation in the decade since its publication. Recently, a New Zealand based conservation group made further recommendations but these too appear to have no better prospect for implementation.

A major drawback is that there is no designated agency or department to undertake the task of identifying, institutionalising and administering a Parks and Reserves system. Whilst it may have once been envisaged that the National Trust for Fiji should undertake this task, it has clearly failed. And following the Garrick Memorial Park debacle other organisations such as the NLTB, Ministry Of Forest and Ministry Of Tourism are taking the initiative and acting independently.

A clear national directive is urgently needed with respect to this issue.

Any future system will more likely be selected on the grounds of what is left rather than by ecological and heritage values. Nonetheless, several outstanding forest areas have been identified which are already known to have major ecological significance and in which no logging has yet taken place. Important amongst these are:

Wabu Creek, Viti Levu;
Sovi Basin, Viti Levu; and
Vunivia, Vanua Levu.

8.4 Compensation for landowners whose forests are reserved or protected in the national interest.

Reservation or protection of forest (and marine) areas in the national rather than the landowner interest, are needed for a variety of reasons including:

- . effective watershed management and flood control;
- . the provision of recreation areas and amenities for the public; and
- . protection of representative habitats, biodiversity attributes, etc.

Given the existing communal land tenure system, the setting aside of forest areas as reserves would require permission and co-operation from their native landowners, who will rightly expect not to be financially disadvantaged. This will no doubt involve considerable short term and long term financial resources.

Tourism has a major role to play in this respect as is currently being initiated at the Bouma Forest Park and proposed Waikatakata Forest Park. However, tourism will not be able to finance all sites and alternative sources will need to be found. International finance is an obvious source, but there is need as well for a national contribution which can cater for all requirements. A Trust Fund administered by the Reserve Bank of Fiji has been widely mooted.

8.5 Archaeological and heritage sites

Archaeological and historic sites of cultural importance.

Fiji has a sole declared National Archaeological Monument - Wasavulu in Vanua Levu. This site is under no formal management and has recently been damaged.

There is no National Register of archaeological or cultural sites of historic interest. At present the Fiji Museum holds files on different sites in conjunction with marked up 1:50,000 maps on which the known sites are located. This coverage is highly localised and even in areas apparently

quite well covered a large number of the existing sites are not included. For instance in 1987, a brief survey of the lower and middle Sigatoka Valley, an area comparatively well researched according to Museum files, revealed that 19 of the 40 sites surveyed were not recorded in the Museum's files.

The most significant work in identifying and collating information on such sites has been that of John Parry based on photo-interpretation. To date his work has covered the Rewa and Navua Deltas, the Sigatoka Valley and (as yet unpublished) west and north Viti Levu.

The absence of a National Register of Historic and Archaeological Sites is of major concern. Such sites are regularly being lost to developments and agriculture through oversight and lack of appreciation of their significance - an example being the major 'Linked Mound' site at Vatumali in the upper Sigatoka Valley, built over during the construction of a school.

Preservation of historic buildings

Recently considerable interest has been generated in the protection of buildings of Fiji's post-European period and this interest is being gradually incorporated into regulations and development approvals.

The best example of this is Levuka, the former capital. Under the provision of the approved Town Planning Scheme, Levuka is declared an historic town with special provisions covering the demolition of existing buildings and the erection of new ones.

Another area where these provisions have been used is in the recently approved Nausori Town Planning Scheme. It includes five different areas of buildings generally belonging to The Methodist Church and the early sugar industry stating that their demolition should be discouraged.

The Momi Gun Site has been restored as an operational tourist attraction by the National Trust for Fiji.

The City of Suva has recently requested an amendment to its Planning Scheme to protect some 50 historic buildings and this amendment should be exhibited shortly.

With increasing interest in Fiji's historic environment it is anticipated that similar amendments to that proposed for the City of Suva may be initiated for other Planning Schemes in the near future.

D PLANNING FOR SUSTAINABLE DEVELOPMENT

9. State of the National Environment

9.1 Characteristics of the Environment

Fiji has many positive qualities derived from the natural environment:

- . a mild climate with plenty of sun and rain;
- . a small population with a moderate growth rate;
- . the absence of many pests and diseases;
- . some major natural resources - land, forests, seas, minerals, landscapes and scenery;
- . hydroelectricity and other potential renewable energy sources;
- . virtual absence of heavy and high-pollution risk industry;
- . relatively low level of poverty compared to other developing countries and a good education provision;
- . history of easygoing lifestyle and harmonious living.

Fiji also has what can be termed environmental liabilities:

- . isolation, small size and geological youth, hence ecological fragility which is vulnerable to violation and abuse;
- . regular exposure to devastating cyclones;
- . preponderance of steeplands, scarcity of arable land and an imbalanced distribution of landholdings;
- . lack of natural oil deposits;
- . economic and agricultural specialisation;
- . major dependence on the coastal zone and consequent vulnerability to rising sea levels;
- . undercurrents of social tension along racial and economic lines;
- . encroaching urgency to hasten the pace of lifestyles.

There is no doubt that Fiji still retains a largely unspoilt environment although the vegetation outside of forest areas has undergone almost total conversion from its original condition. We will never fully understand exactly what has been lost in this process. Fiji lacks the serious demographic, economic and industrial pressures from which the majority of serious environmental problems originate. But conversely, its small size, young landscape and evolutionary isolation make its environmental resources very vulnerable to loss or degradation. In addition, the vast majority of the population, industry, important infrastructure and economic activity is located in the coastal zone, which is an ecologically complex area highly susceptible to both natural hazards and human violation. This zone will receive the major impacts of global warming.

9.2 Issues of concern

Unsustainable resource use

Fiji is fortunate in having considerable resources, timber, land and marine products, and some minerals. But in recent years the exploitation of these has not been sustainable, in effect these resources have been 'mined' to obtain a quick economic return without effective environmental and social considerations and regard for the future. Nothing exemplifies this more succinctly than the rise and collapse of the beche de mer and clam meat industries. But this trend is not confined to marine products, it is currently happening in the forests and in agriculture - poor logging and forest management is 'mining' the timber and water catchment resources, the ginger industry is 'mining' soil resources, so too is sugar cane on the marginal foothills. Over the years, many development assistance agencies have encouraged this blinkered approach through their focus on narrow economic targets. It is unfortunate that this is now changing (even if slowly), because Fiji's resources are not large enough to absorb such treatment indefinitely.

Pollution and the urban environment

The urban environment

Many of Fiji's more serious environmental problems, some highly visible, others not, are occurring in urban areas or their immediate vicinity. Fiji's population growth rate is moderate, but its urban and peri-urban growth rate is high, and is clearly outstripping infrastructural planning and development. Thus it is primarily responsible for the important social issues of environmental concern, such as housing, water and sanitation.

Agricultural developments in peri-urban areas to supply urban needs are also producing some of Fiji's worst examples of land degradation.

Pollution

Pollution is an issue of grave concern not so much because the levels are suspected to be dangerously high, but because there is no monitoring in place for the nation to ever learn whether there is a danger. While there is some control on potential new polluters in the form of planning restrictions, established polluters continue effectively unconstrained by any Government intervention or public concern.

Waste disposal

Waste disposal is a national dilemma, the location and management of every municipal tip in Fiji indicates a total disregard for internationally acceptable standards.

Genetic and biodiversity resources

Fiji's vegetation and wildlife is inconspicuous and generally lacks species of popular appeal, nonetheless the genetic and biodiversity resources they contain are of major significance. Their cultural, national and tourism significance is vastly undervalued, weighed down by a widespread misconception that anything imported is better. The current protected areas are totally inadequate in number, size, choice of location and management to make any meaningful commitment to the long-term conservation of Fiji's natural heritage.

9.3 Community awareness and participation - the key to the future

Fijian landownership and customary rights and their future management are central to sustainable development and sound environmental management. The Government clearly accepts these rights as expressions of social structure and cohesion and so basic to the continuing welfare of Fijian society. Yet Government feels obliged to promote and implement developments which appear not to be fully accepted by landowners. While resource use problems associated with traditional rights, foreshore reclamation, rivers and streams, agricultural land practices, land use etc, are being ignored or treated superficially for political fear of confronting the landowners.

Resolution of this dilemma is one of the primary challenges that must be met. The problems of Papua-New Guinea's troubled island of Bougainville are a classic, if extreme, example of the consequences of failing to effectively involve local people and landholding groups in development decisions on resources over which they have traditional rights.

An approach to resolving this will require at least two major components:

- . a national land use plan which is derived not solely through a technical land-capability assessment but which is reached through consensus based on full community participation; and
- . a major effort to provide a special form of community education required to give traditional community decision makers the technical and other knowledge they would need to manage the environment and resources in a modern development context.

The successful approach to conservation and development would aim to use the best modern resource management practice in conjunction with the traditional to obtain a 'home-grown' style of sustainable development. This will not be easy, for youth, the heirs to customary land and sea areas are now the

target of formal education. This prepares them for roles outside of their traditional communities so they face a growing problem of alienation. This could have serious implications for sustainable development in the future.

Considerations of land and resource use inevitably centre on the role of the traditional landowners, but the role of the Indian community, effectively disenfranchised from resource allocation and decision-making, will always be crucial to the attainment of sustainable resource use because of their entrepreneurial skills and dominant role in the economy.

9.4 Future directions - Government initiatives

Government's intentions are evident in numerous policy statements and there have been some notable initiatives, although there is some way to go before it will be able to exercise the control that is needed. The setting up of an Environment Unit is a major step forward, while the two year National Environmental Management Project, funded through a grant from the Asian Development Bank, will draw up a National Environment Strategy covering all aspects of the Government's environmental management and control into the next century.

By establishing the Environment Unit within the Ministry of Housing and Urban Development, Government has moved to initiate environmental control through the planning process for new projects and developments, but very little has been achieved in tackling existing problems and abuses. This aspect is basically being left to the appropriate Ministries and Departments. However, there can be little future in this alone. Even if the legislation was appropriate, and it is lacking in many important instances, it has been demonstrated in many Governments and is obvious in Fiji too, that within a resource managing ministry, issues of production, development, revenue and cost considerations will always prevail over environmental concerns.

While it is envisaged that environmental management itself will always be undertaken by ministries, statutory bodies and other government agencies, it needs to be directed in co-ordination with overall environmental policy, by a centralised Government capability. This will need to be powerful to ensure national goals dominate short-term sectoral objectives and professionally staffed and resourced to ensure that the correct decisions are made as quickly as possible.

10. NATIONAL ENVIRONMENT MANAGEMENT PROJECT

10.1 Prioritising Sustainability Issues

The proforma outline for UNCED national reports prepared by SPREP stated that 'Part D - Planning for Sustainable Development' should discuss the priorities, action required and policy adjustments necessary in relation to sustainability issues. However, the Fiji UNCED Committee made a deliberate decision that the National Report should not pre-empt the outcome of the national Environment Management Project (NEMP) which is currently preparing a National Environment Strategy for Fiji.

The discussion in the preceding chapters of this report has, in fact, highlighted issues and problems of concern and their root cause in an evaluative manner with appropriate comments on needs for changes in policy and action. Most of the material has been derived from the NEMP 'State of the National Environment Report', in draft form at the time of writing.

While it is considered premature to make definitive recommendations at this stage of the project it is considered relevant to describe the nature of NEMP in terms of its objectives and work programme. It does represent, after all, the Government's response to the acknowledged need to develop a strategy for long term sustainable development.

The project, funded by an Asian Development Bank technical assistance grant, commenced in August 1990 having originated in 1988 as part of a large Agricultural Diversification Loan Programme. The project is managed by the Department of Town and Country Planning's Environment Unit and is scheduled for completion in August 1992.

10.2 Objectives

The objectives of the technical assistance are:

- . To assist the Environment Unit of the Department of Town and Country Planning (DTCP) to formulate a national environment strategy which is consistent with sound economic development. A plan and program for guiding the development and management of environment and natural resources will be prepared to ensure that development is sustainable, and ecologically sensitive resources are adequately protected.
- . To provide adequate information systems through effective environment monitoring of ecologically sensitive areas (ESAs). Monitoring the environment should be cost-effective, affordable and institutionally viable.

- . To provide training for selected staff of DTCP and other Government agencies.
- . To promote public awareness and education as a key component of a national environment management program.

10.3 Scope and work program

Assessment of the State of the Environment

- . Collect, collate and evaluate various sector studies relating to natural resource development and/or management, environment assessments, pollution studies and other related documents.
- . Utilizing a review of the documents, supplemented with comparative analysis of old and new satellite imagery or aerial photos, prepare an evaluation and, to the extent possible, quantification of the losses of forest cover, encroachment on areas presently proposed as protected areas, and other similar effects of land use changes on the natural resource base.
- . Based on the above information and discussions with concerned Government officials, select the highest priority sites/areas which are considered critical natural resources, either for watershed benefits, water resources, tourism, fisheries, etc. but where human activities threaten the capability of the resources to provide such benefits. Evaluate such sites and describe: the previous/existing/potential benefits; the activities that may result in reduction of such benefits; and the types of management measures required to ensure optimization of beneficial uses. The selected site/area studies will be used as case studies in the State of Environment Report.
- . Prepare a preliminary assessment of the most critical types of environment and resource management/use/degradation problems and efforts required to resolve major conflicts in resource use.
- . Prepare schematic illustrations of the types and location of problems which can be utilized in a public information program.
- . Present results of the state of environment assessment on a national environment base map utilizing satellite imagery and/or aerial photography.
- . Based on results of above, prepare a State of the Environment Report (to be the Interim Report) suitable for distribution as an information document.

Ecologically sensitive areas (ESAs)

- . Define classification criteria for ESAs based on information from the assessment of the state of environment and based on current Government classification criteria (such as for watershed classifications, coastal classifications, forest classifications, etc.).
- . Prepare preliminary quality criteria for each classification which will enable an assessment of the relative quality of each ESA.
- . Prepare a base map of ESAs (based on information collected during the previous assessment) using the classification criteria. Based on available information, give preliminary priority to the most important ESAs. Importance may be based on economic value, uniqueness, current threat to environment quality, cultural values, etc.
- . Carry out field site evaluations for visual survey of conditions and validating maps.
- . For each site visited, prepare a description of existing environment conditions, human activities, etc.
- . Describe preliminary indication on economic and socioeconomic values of selected site, including present and projected potential values.
- . Describe existing or potential conflicts of use of resources at each site as well as mutually beneficial uses.
- . Describe various likely developments for each site and the types of environment/natural resources, management measures (and their estimated costs) which will be required for sustained use of the resources under the different scenarios.
- . For the 10 most critical ESAs, recommend terms of reference for preparation of management plans.
- . Prepare terms of reference for a long-term ESA monitoring program.

Legislative needs

Assess the state of environment and ESA evaluation to identify shortcomings in existing legislation and enforcement in terms of ensuring sustained and optimum long-term use of resources. A legislative analysis and recommendations will be prepared including review of existing legislation relating to management of natural resources and environment quality;

identification of conflicts, gaps, or shortcomings; assessment of degree of actual enforcement and recommendations for amendments or new legislation needed for adequate management of natural resources with particular attention to ESAs.

Guidelines for management of ESAs

Prepare guidelines for project and program planners to assist them to integrate environment management objectives when planning projects or programs which may have significant effects on ESAs. These will include specific guidelines for environment aspects of land use planning, coastal zone planning, tourism development planning and protected area planning.

Management Plans for selected ESAs

Prepare management plans for the most critical ESAs including at least one protected area management plan and one coastal resource/tourism management plan. These management plans will serve as prototype plans to assist the Government in the preparation of similar plans for other ESAs. Detailed monitoring plans will be included. The management plans should also identify any special environment protection measures or projects that would gain acceptability from decision makers based on cost effectiveness of projected environment conditions with and without the protection/project and provisions for integrating environment protection needs with economic and socioeconomic gains.

Monitoring program

Develop a long-term key component of a national environment strategy which provides for periodic review/updating of the environment strategy and review of implementation of environment policies.

- . Review and evaluate existing monitoring programs relating to environment and natural resource sectors and describe and quantify additional baseline survey/monitoring needs and data management needs.
- . Prepare recommended minimum comprehensive national environment monitoring program including economic, financial and institutional as well as technical aspects, including: economic analysis (to the extent possible) to demonstrate its efficiency; recommended institutional plan, showing participation of all interested government agencies with coordination by the Environment Unit; and suggestions for financing.
- . Initiate site specific monitoring/feedback systems for selected ESAs for which management plans have been prepared.

Public Awareness and Information Program

Develop a public awareness program as an essential component of environment planning and management. This is especially important in developing countries such as Fiji where public understanding of environment principles and issues need to be enhanced. Therefore, it is important to implement a public environment awareness/education program consisting of preparation and dissemination of relevant information in various media for example: radio programs, posters, pamphlets/booklets, video recordings, public meetings/seminars. Aside from raising public awareness with regard to environment issues/principles, it is also considered important to promote the actual environment program being implemented by the Government with provision for public participation. Specifically:

- . Advise and assist DTCP and other concerned agencies in planning an environment awareness and information dissemination campaign which would be initiated during the technical assistance.
- . Prepare a five-year plan and corresponding guidelines for conducting an environment and natural resources public information and education program for future use by the participating Government agencies.

E PROCEDURAL MATTERS

This report has been developed under the auspices of a UNCED Committee acting as a sub-committee to the National Environment Steering Committee (NESC). NESC has been established to oversee the preparation of the National Environment Strategy through the National Environment Management Project. The steering committee is comprised of representatives from the following ministries, instrumentalities and statutory authorities:

- . Foreign Affairs
- . Finance and Economic Planning
- . Primary Industries
- . Fijian Affairs and Rural Development Education
- . Health
- . Lands and Mineral Resources
- . Tourism, Civil Aviation and Energy
- . Infrastructure and Public Utilities
- . Solicitor-General
- . Conservator of Forests
- . Women and Culture
- . Town and Country Planning
- . Native Land Trust Board
- . Ports Authority
- . National Trust

The report was endorsed at the Fiji Interim Government Cabinet meeting on 23th July, 1991.

Table 1: Estimates of storm surge heights since 1972

EVENT	ESTIMATED STORM SURGE HIGHEST (M)	LOCATION
23-25 Oct 1972 Bebe	*	N.W. Viti Levu
1979 Meli	2-3 metres	Nayau/Southern Viti Levu
31 Jan-2 Feb 1975 Val	*	
5-6 April 1925 Betty	2 metres	Viwa/S.W. coastal Viti Levu
28-30 Dec 1978 Fay	*	Lau Group
24 Mar 1980	*	Savusavu, Vanua Levu
24 Feb-2 Mar 1983 Oscar	3-4 metres	Nadi Bay, Momi, Mbengga
14-19 Jan 1985 Eric	2-3 metres	Lautoka/Vuda
14-21 Jan 1985 Nigel	2 metres	Viwa Island, N.W. Viti Levu
10-18 March 1985 Hina	1 metre	Southwest Viti Levu

Source: Fiji Meteorological Service

* No estimates available but surge known to have occurred.

Table 2: Data on rainfall intensity for the Fiji Islands*

	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
Average Rainfall (mm)													
Suva	324	315	383	385	254	172	147	140	209	220	266	272	3087
Nadi	293	293	358	185	84	81	48	61	87	95	14	175	1892
Labasa	400	397	422	279	98	71	57	57	87	149	204	223	2445
Maximum Rainfall (mm)													
Suva	641	832	799	960	918	419	408	523	481	900	773	571	
Nadi	598	606	918	406	206	266	190	286	279	342	461	398	
Labasa	835	1068	846	645	231	250	214	287	250	491	675	564	
Max. Rainfall in 1 day (mm)													
Suva	293	282	196	308	281	188	234	186	214	346	347	195	
Nadi	236	217	242	173	141	103	122	171	125	269	119	272	
Labasa	218	245	180	141	76	89	171	97	55	120	153	99	

Source: Fiji Meteorological Service

Table 3: Effects of global warming

Global warming will have an impact in the South Pacific on:

- climate and water supplies
- vegetation and soil
- agriculture and forestry
- health and disease patterns
- human comfort

Sea level rise will produce:

- permanent coastal inundation
- episodic coastal flooding
- changes to coastlines
- intrusion of sea water into estuaries
- rises in water tables
- changes in coastal vegetation, animal and fish species
- increased mud and sediment in productive waters.

Global warming and sea level rise will have social and economic impacts on the South Pacific islands, such as:

from climate changes:

- costly public works to handle increased rainfall in some areas
- decreased agricultural production due to draught in some areas
- loss of agricultural land
- changes in fishing grounds
- rising power demands for air-conditioning
- domestic and industrial water supply problems
- transformations in the tourism potential for many island States, generally for the worse
- threats to some entire ecosystems

from sea level rise:

- saltwater contamination of drinking water
 - poorer crop production from rising saline water tables
 - economic costs for engineering structures and sewage systems will increase
 - emigration and resettlement of communities
 - societies will lose younger and more active members to migration
 - land management practices will have to change
 - local and national economies will be reshaped, particularly with regard to marine and coastal resources
 - loss of outlying islands and control over marine resources in the associated economic zone
 - loss of cultural heritage, psychologically and physically
 - major economic and social transformations because of changed land values.
-

Table 4: A Comparison of two land use assessment of Fiji's lands

Land Use	Twyford & Wright (1965)		EEC Mission-1984 (Based on MPI)	
	ha	%	ha	%
: Suitable for agriculture (arable, tree crop, grazing)	549,000	30	1,079,900	59
: Can be developed in the longer term with much attention	586,800	32	--	--
: Suitable for marginal grazing and forestry	511,300	28	652,300	35
: Unsuitable for either agriculture or productive forestry	190,800	10	105,700	6

Source: Fiji Forestry Sector Review, FAO (1988)

Table 5: Estimate of the forest resource in Fiji

	Hectares	%*
<u>Natural Forest Areas:</u>		
Production Forests	237,300	13
Under concession agreements:	143,128	
No concession agreement :	94,172	
Protection/Conservation	269,100	15
Non-Commercial	298,500	16
Sub-Total	804,900	44
<u>Plantation Forests:</u>		
Softwoods: Fiji Pine Commission	32,500	2
Private	10,800	1
Hardwoods: Forestry Department	42,000	2
	85,300	5
Total	890,200	49

Source: Extracted from Forestry Sector Study (FAO 1988), with additional data from the Ministry of Forestry, and Fiji Pine Commission Ltd, 1991. Figures rounded.

Note: * % of total land mass of 1,827,200 ha.

Table 6: Value of fish, catch, imports & exports F\$ thousand

	1987	1988	1989	1990est
1. Finfish catch for domestic sale	11,464	12,009	14,716	15,500
2. Non-finfish catch for dom.sale	1,754	2,867	2,774	3,300
3. Tuna catch for export canning	7,600	16,600	14,732	12,500
4. Other catch for export	8,527	9,227	10,602	13,700
Fiji commercial catch	29,345	40,703	42,823	45,000
5. Whole Fish imports, (incl tuna for canning)	8,165	9,817	11,178	7,600
6. Canned Fish import	3,650	3,674	4,144	3,500
Total Imports	11,815	13,491	15,322	11,100
Total commercial fish supply	41,160	54,194	58,145	56,100
7. Estimated value of subsistence catch	30,000	34,000	43,000	48,000
Total fish supply	71,000	88,000	101,000	104,100
8. Canned tuna export	20,800	39,700	39,400	50,000
9. Other exports	8,500	9,200	10,600	18,700
Total Exports	29,300	48,900	50,000	68,700

Source: Fisheries Division, MPI.

Table 8

Total Imports and Structure

\$ million c.i.f.

	1986	1987	1988	1989(r)	1990(p)
Total Imports	493.6	465.1	658.7	864.3	1015.6
Percent Change	-2.8	-5.8	41.6	31.2	17.5
Percent of:					
Food, Beverages					
Tobacco	16.5	18.4	17.6	15.1	12.4
Fuel	17.2	17.0	14.1	14.4	14.9
Chemicals	8.4	8.6	10.0	9.0	7.4
Manufacturers	20.9	22.3	23.5	23.7	22.5
Machinery	23.5	19.4	21.1	25.5	31.2
Other	13.5	14.3	13.7	12.3	11.7

Source: Bureau of Statistics and Central Planning Office

Table 9: Imports by Economic Category

Imports: (F\$M, May 1991)

Economic Category	1988	1989 Prov	1990 Prov	Percent Change	
				1989 Prov	1990 Prov
Food	110.8	123.6	130.4	11.6	5.5
- Fish	28.8	27.6	17.1	-4.2	-38.0
Beverages & Tobacco	5.0	6.5	7.8	30.0	20.0
Crude Material	4.3	7.7	7.5	79.1	-2.6
Mineral Fuels	88.6	117.0	157.8	32.1	34.9
- motor spirit	13.7	19.8	28.4	44.5	43.4
- aviation turbine fuel	20.2	26.5	21.7	31.2	-18.1
- automotive distillate fuel	22.3	33.2	46.8	48.9	41.0
- industrial distillate fuel	11.8	12.3	16.7	4.2	35.8
Oils & Fats	11.6	9.6	11.2	-17.2	16.7
Chemicals	66.1	77.5	81.5	17.2	5.2
Manufactured Goods	155.0	205.1	243.1	32.3	18.5
- textiles	56.9	78.7	94.8	38.3	20.5
Machinery & Transport Equipment	138.9	221.0	340.0	59.1	53.8
- road vehicles	16.7	66.4	70.1	279.6	5.6
- other transport equipment	27.2	8.4	95.4	-69.1	1035.7
Miscellaneous Manufactured goods	57.4	84.7	105.9	47.6	25.0
- garments	7.2	12.5	14.2	73.6	13.6
Other Commodities	21.1	11.6	11.7	-45.0	0.9
Total	658.8	864.3	1096.9	31.2	26.9

Source: Bureau of Statistics

Table 10

Summary of the Current Account

\$ million

	1986	1987	1988	1989	1990 (est)
Trade Balance	-136.7	-10.3	-57.2	-153.8	-251.7
Services (net)	160.3	59.9	117.7	243.1	243.8
Receipts	337.2	279.5	368.4	566.6	617.4
Travel	185.4	146.2	182.6	295.5	325.9
Others	151.8	133.3	185.8	270.1	281.5
Payments	176.9	219.6	250.7	323.5	373.6
Investment Income (net)	-42.2	-45.6	-46.1	-54.3	-45.8
Private Transfers	-6.0	-23.4	-5.1	-19.3	-39.3
Government Transfers	16.7	12.6	48.2	51.3	60.7
Current Account Balance	-7.9	-6.8	57.5	67.0	-32.3

Source: Bureau of Statistics

Table 11

Income Per Head

	1987	1988	1989	1990 (est)
GDP at Factor Cost (F\$m)	1310.3	1384.9	1598.1	1817.7
Population ('000)	720.6	718.4	722.2	725.9
Change (%)	0.7	-0.3	0.5	0.5
GDP per Head (F\$)	1818	1928	2213	2504
Change (%)	-1.3	6.0	14.8	13.2
At 1977 Prices:				
GDP per head (F\$)	993	1005	1122	1165
Change (%)	-6.8	1.2	11.6	3.8

Note: Population at mid-year

Source: Bureau of Statistics and Central Planning Office

Table 12: Population of Fiji 1921-1986 (in thousands)

Census Year	Fijians Rate %	Indians Rate %	Others Rate %	Total Rate	Growth %
1921	84 (54%)	61 (39%)	12 (8%)	157	+1.2%
1936	98 (50%)	85 (43%)	15 (8%)	198	+1.6%
1946	118 (45%)	120 (46%)	22 (8%)	260	+2.7%
1956	148 (43%)	169 (49%)	28 (8%)	345	+2.9%
1966	202 (42%)	241 (51%)	34 (7%)	477	+3.3%
1976	260 (44%)	293 (50%)	35 (6%)	588	+2.1%
1986	329 (46%)	349 (49%)	37 (5%)	715	+2.0%

Source: Bureau of Statistics, Suva.

Table 13: Fiji population composition
1966-1986 Projected 1996-2011
(Thousands)

ETHNIC GROUP	YEAR	AGED 0-14	AGED 15-64	AGED 65+	TOTAL
FIJIAN	1966	89.7	106.8	5.8	202.2
	1976	107.8	143.9	7.9	251.7
	1986	129.5	188.3	11.4	329.3
	1996	149.2	236.8	14.9	400.9
	2006	149.6	297.4	21.1	468.1
	2011	148.7	326.3	24.5	499.5
INDIAN	1966	119.1	117.3	4.4	241.0
	1976	120.3	167.6	4.9	292.9
	1986	131.4	209.2	8.1	348.7
	1996	105.3	229.2	11.3	345.8
	2006	87.2	245.8	17.9	350.9
	2011	81.9	244.3	22.8	349.1
ALL	1966	222.7	242.3	11.4	476.4
	1976	241.8	331.7	13.8	587.3
	1986	273.5	418.6	21.0	713.1
	1996	265.2	484.6	28.1	777.9
	2006	244.8	560.7	41.0	846.5
	2011	237.6	586.9	49.4	874

Source: NEMP Consultants

Table 14: Dependency ratios

ETHNIC GROUP	YEAR	CHILD	OLD	TOTAL
FIJIAN	1966	84.1	5.4	89.5
	1976	75.0	5.5	80.5
	1986	68.8	6.1	74.9
	1996	63.0	6.3	69.3
	2006	50.3	7.1	57.4
	2011	45.6	7.5	53.1
INDIAN	1966	101.5	3.8	105.3
	1976	71.8	2.9	74.7
	1986	62.8	3.9	66.7
	1996	45.9	4.9	50.9
	2006	35.5	7.3	42.8
	2011	33.5	9.3	42.9
ALL	1966	91.9	4.7	96.6
	1976	72.9	4.2	77.1
	1986	65.3	5.0	70.4
	1996	54.7	5.8	60.5
	2006	43.7	7.3	51.0
	2011	40.5	8.4	48.9

Source: NEMP Consultants

Population densities for FIJI 1966 - 1986

Table 15

PROVINCE	LAND AREA (Km2)	DENSITY PERSONS PER Km2		
		1966	1976	1986
BA	2633.7	51.6	63.4	75.0
BUA	1378.9	7.1	8.3	10.1
CAKAUDROVE	2815.8	10.7	12.2	14.4
KADAVU	478.0	18.1	18.2	20.5
LAU	487.5	32.8	29.6	29.1
LOMAIVITI	410.7	32.3	33.0	39.1
MACUATA	2003.7	22.2	28.7	37.3
NADR/NAVOSA	2384.8	15.7	19.3	22.8
NAITASIRI	1666.4	23.7	39.1	60.1
NAMOSI	569.7	4.8	5.8	8.5
RA	1341.0	16.6	19.0	23.3
REWA (EX SUVA)	251.7	27.1	93.9	110.3
SUVA CITY	20.4	2656.9	3121.6	3417.8
SERUA	830.4	9.9	13.6	16.1
TAILEVU	955.5	35.7	41.8	46.3
ROTUMA	45.5	73.9	61.6	59.0
TOTAL FIJI	18273.5	25.5	32.2	39.1

Source: Bureau of Statistics

Table 16: Dengue Fever Incidence
1985 to 1990

Year	No. of Cases

1985	31
1986	269
1987	1
1988	22
1990	2225

Source: Fiji School of Medicine

Table 17: Pests of major quarantine concern in Fiji

CROP	PEST COMMON NAME	DISTRIBUTION
Banana	Moko disease Banana fruit fly	S. & C. America, Philippines, Bangladesh Australia, Indonesia, Philippines, PNG, Solomon Islands
Cassava	Cassava mealybug Green cassava mite bacterial blight	S. America, C. & W. Africa S. America, Africa. America, S. Asia, FSM, Guam, Palau
Citrus	Citrus greening Mediterranean Fruit fly	S. & E. Asia, S. & E. Africa. Europe, near East, Africa, W. Australia, Hawaii, C, & S. America
Coconut	Lethal yellowing Foliar decay Cadang cadang	C. America, Florida, Jamaica, W. Africa Vanuatu Guam, Philippines, Solomon Islands
Sugar cane	Dwarf virus Ramu stunt disease Gumming disease	Australia Papua New Guinea Australia, S. & C. America, Africa, Indonesia
Dalo	Taro Leaf Blight	FSM, Hawaii, Palau, Papua New Guinea, Solomon Islands

Source: IUCN Consultants

ENERGY SOURCES FIJI										
YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1990	1990
(a) Retained imports of petroleum (Liters x 10 ⁴)										
Avtur/Jet A1	6.7	11.0	20.5	4.4	-6.0	3.5	-12.7	-31.2	9.6	
Avgas	0.8	1.1	1.3	2.7	1.3	1.5	0.8	3.5	3.5	
MS	50.5	55.1	60.5	55.5	57.0	41.4	58.2	68.5	68.5	
ADO	90.4	88.9	88.2	88.7	71.2	82.1	91.1	102.4	102.4	
IDO	72.7	21.2	29.9	27.8	23.9	35.2	31.3	42.4	42.4	
Kerosene	15.9	10.6	11.4	16.3	20.7	26.9	38.6	60.8	20.0	
RFO	5.2	3.8	7.2	4.3	-0.2	5.0	6.7	3.7	3.7	
Sub total	242.2	191.7	219.0	199.7	167.9	195.6	214.0	250.1	250.1	
(b) Other Fuels (kg x 10 ³)										
LPG	4.2	3.9	4.0	3.7	4.8	4.3	6.2	6.0	6.0	
Coal/Coke	18.0	22.4	16.4	15.2	5.7	5.5	14.4	19.2	19.2	
Bagasse	530.0	900.0	720.0	998.0	763.0	772.0	936.0	900.0	900.0	
Wood	253.0	260.0	267.0	273.0	280.0	287.0	287.0	290.0	290.0	
Electrical Energy (Wh x 10 ³)										
Source										
Hydro	40.0	287.0	304.0	332.0	330.0	340.0	341.0	na	345.0	
Diesel	210.0	19.0	18.5	19.7	17.3	21.4	25.0	na	26.0	
Bagasse	28.7	47.7	40.2	46.9	39.7	34.2	49.9	na	48.0	
Total El.	278.9	353.7	362.7	398.6	387.0	395.6	415.9	na	419.0	

Table 18: Energy sources in Fiji -- by weight and volume

ENERGY SOURCES FIJI (JOULES X 10 ¹²)										
	Conv.f	1983	1984	1985	1986	1987	1988	1989	1990	1990
Avtur/JetA 1	38.6	0.24	0.40	0.75	0.18	-0.22	0.13	-0.46	-1.14	0.26
Avgas	33.8	0.03	0.04	0.04	0.09	0.04	0.05	0.03	0.12	0.12
MS	34.6	1.74	1.90	2.09	1.91	1.97	1.43	2.01	2.36	2.38
ADO	38.6	3.48	3.42	3.40	3.41	2.74	3.18	3.51	3.94	3.94
IDO	38.0	2.76	0.81	1.14	1.06	0.91	1.34	1.19	1.61	1.61
Kerosene	38.6	0.68	0.39	0.42	0.69	0.78	0.98	1.41	2.22	0.73
RFO	37.0	0.19	0.14	0.27	0.18	-0.01	0.19	0.26	0.14	0.14
Subtotal		9.03	7.10	9.09	7.39	8.18	7.27	7.93	9.26	9.26
LPG	46.0	0.19	0.18	0.18	0.17	0.22	0.20	0.29	0.28	0.28
Coke/Coal	29.0	0.52	0.66	0.48	0.44	0.17	0.18	0.42	0.56	0.56
Bagasse	8.0	4.24	7.20	5.76	7.98	8.10	8.18	7.49	7.20	7.20
Wood	12.0	3.04	3.12	3.20	3.28	3.36	3.44	3.44	3.48	3.48
Electricity	3800	0.14	1.03	1.09	1.20	1.18	1.22	1.23	1.50	1.50
TOTAL		17.18	19.28	18.81	20.46	17.23	18.47	20.79	22.26	22.26

Table 19: Energy sources in Fiji by energy equivalent

Registered Motor Vehicles in Fiji					
	1985	1986	1987	1988	1989
Private Cars	27699	28646	29262	29713	31924
Rental Cars	2559	2736	2882	2944	3280
Goods Veh.	21539	22443	23029	23523	24548
Buses	1260	1280	1289	1294	1302
Tractors	4366	4450	4499	4540	4685
Motorcycles	3826	3924	3984	4040	4090
Taxis	2195	2218	2236	2238	2285
Other	2843	2957	3025	3116	3226
TOTAL	66287	68654	70206	71048	75340

Table 20: Registered motor vehicles in Fiji

Table 21 - Industrial production index

	Base 1977 = 100		Base 1986 = 100		
	1986	1987	1988	1989	1990
Food Processing	140.0	130.3	88.4	101.5	98.
Garments	n.a.	n.a.	175.2	257.1	382.
Sawmilling & Veneer	131.4	147.5	109.3	90.2	96.
Paper & Printing	140.1	110.5	70.2	73.8	87.
Miscellaneous	154.2	112.1	84.4	80.6	81.
Building Materials	124.3	73.2	56.6	57.6	77.
All Manufacturing	137.0	121.0	87.1	96.8	106.

Source: Bureau of Statistics.

Table 22 : Sewerage facilities in some urban areas of Fiji

Town	Population (1986 Census) plant (EP)	Capacity of Sewage treatment	Point of sewage discharge waste
Suva	141,273	50,000 (Kinoya) 15,000 (Raiwaqa)	Laucala Bay Vatuwaqa River
Labasa	16,537	6,000	
Nadi	15,220	10,000	Nadi River downstream of the town
Lautoka	39,057	25,000	Sea outfall, inside Barrier Reef
Sigatoka	4,730	4,000	Mouth of Sigatoka River
Nausori	13,982	6,000	Rewa River bridge

Source: Institute of Natural Resources, USP

Note: EP : Estimated Population

Table 23: Value and volume of imported pesticides
(includes a proportion that are re-exported).

Pesticide	1989 F\$	1989 Kg	1990 F\$	1990 Kg
Pesticides'	1,315,664	196,521	1,110,650	135,207
Fungicides	97,827	13,274	78,233	7,677
Herbicides	350,911	40,083	508,050	44,127
Mosquito Coils	252,687	173,270	168,335	139,405
Totals	2,017,089	423,148	1,865,268	326,416

Source: Fiji Government Bureau of Statistics

Note: 1. Included here: Insecticides, rodenticides, nematocides, fumigants.

Table 24 : List of most commonly used pesticides.

PESTICIDE	Hazard class	Crop use	Remarks
Herbicides			
2.4.D	Moderately	Sugar cane	Often sold mixed with other active ingredients.
asulam	Very low	Sugar cane & veg.	
dicamba	Very low	Sugar cane	This and 2,4. D are the most used
ioxynil	Moderately	Sugar cane	
MCPA	Slightly	Rice	
paraquat	Moderately	Veg., planta-	
propanil	Slightly	cane Rice	
Insecticides			
acephate	Slightly	Rice and veg.	
Bacillus th'	Very low	Vegetables	Bacterium
BPMC	Moderately	Rice	
carbaryl	Moderately	Rice & veg.	Harmful to bees
chlorfluazuron	Very low	Vegetables	Insect growth regulator
diazinon	Moderately	Rice	Harmful to bees
MIPC	Moderately	Rice	Harmful to bees
pyrethroids	Very low	Vegetables	Toxic to fish
Fungicides			
Copper based	Slightly	Cocoa	Black pod control
benomyl	Very low	Vegetables	
Nematicides			
dazomet	Slightly	Ginger	
methyl bromide	Not classified	Ginger	Used by licensed operators only
metam-sodium	Moderately	Ginger	

Source: National Environmental Management Project

Note: 1. Hazard Class: Follows the WHO recommended classification of pesticides by hazard.

Fiji's environmental laws

Table 25

Legislation	Outline of Provision	Penalty	Authority Responsible
Land and Resource Use			
Mining Act 1966 (Cap 146)	- Compensation for damage - Restoration of land	Max fine \$200 and/ or 6 months imprisonment	Director of Mines & Ministry of Land & Mineral Resources
Forest Act 1953 (Cap 150)	Minister may declare nature reserves and silviculture areas in reserved forests and declare native land to be a protected forest.	Max fine \$300 and/ or 6 months imprisonment	Conservator of Forests & Ministry of Forestry
Town Planning Act 1946 (Cap 139)	Minister may order area to be a town planning area: permission of local authority and Director of DTCP required for development. Preservation of historic buildings and objects of historic or scientific interest.	Max fine \$100 or 3 months imprisonment \$20 per day for infringment	Director of Town & Country Planning & Ministry of Housing & Urban Development
Native Land Trust Act 1940 (Cap 134)	Can lease Native Land (which is not Native Reserve land) with restrictions regarding land use.	Civil Remedies	Native Land Trust Board
Land Development Act 1961 (Cap 142)	Land Development Authority promotes and assists the investigation, formation and carrying out of projects for the development, improvement and settlement of the land.		Land Development Authority
Land Conservation and Improvement Act 1953 (Cap 141)	Land Conservation Board may make 'Conservation Orders' Contravention of such order is an offence.	Max fine \$200 and/or 6 months imprisonment	Land Conservation Board, Ministry of Primary Industries
Agricultural Landlord Tenant Act 1966	Stipulates 'good husbandry practices' by tenants.		
Conservation and Quarantine			
Birds and Game Protection Act 1923 (Cap 170)	Wounding, killing, selling, holding in captivity or exporting protected birds is an offence.	Max fine \$50 or imprisonment max 3 months.	Ministry of Primary Industries.

National Trust for Fiji Act 1970 (Cap 265)	- power to purchase land - may enter into voluntary agreements to protect the land.		Ministry of Housing & Urban Development
Preservation of objects of Archaeological and Palaeontological interest Act 1978 (Cap 264)	- Power to declare and acquire National Mounments' - Preservation of Mounments	Max fine \$200 or 6 months imprisonment	Board of Trustees of Fiji Museum and Ministry of Women and Culture
Plant Quarantine Act 1982; Noxious Weeds, Pests and Disease of Plants Act 1964, (Cap 133)	- Quarantine powers including declaration of noxious pests, infested places; removal of pests; prohibited imports		Ministry of Primary Industries
Animal Importations Act (1970)			Ministry of Primary Industries
Marine and Pollution/Conservation -----			
Marine Spaces Act 1977 (Cap 158A)	- Management and conservation of fisheries within Fiji's economic zone (200 mile limit). - Licencing of foreign fishing vessels.	Maximum fine \$100,000	Office of the Prime Minister
Fisheries Act 1941 (Cap 158)	- Licence to fish required - Non Fiji registered fishing vessel fishing without Licence - Use of dynamite	Max fine \$50 and/or 3 months imprisonment Max fine \$100 Max fine 12 months and /or \$200 fine	Ministry of Primary Industries
Fisheries Regulation 1965	- Prohibited methods and areas e.g. poison - Protection of turtles, etc.	3 months imprisonment and/or \$50 fine	
Continental Shelf Act 1970 (Cap 149)	Oil pollution of a 'designated areas' resulting from escape from pipeline or as a result of exploration.	Max fine \$3,000	Ministry of Lands and Mineral Resources
Ports Authority of Fiji Regulations 1990	Various offences relating to pollution of port areas	Max fine \$400.	Ports Authority of Fiji
Water Pollution -----			
Rivers and Streams Act 1882 (Cap 136)	Rivers belong to the Crown and are for enjoyment of public.		

Irrigation Act 1973 (Cap 144A)	Offence to pollute water in Irrigation Works.	Max fine \$200 or 6 months imprisonment	Commissioner for Irrigation and Ministry Primary Industries
Drainage Act 1961	Offence to interfere with public drainage work i.e. work for the purpose of draining land or of preventing or mitigating flooding or erosion	Max fine \$200 or 6 months imprisonment	Appropriate Drainage Board and Ministry of Primary Industries
Water Supply Act 1955 (Cap 144)	Offence to pollute water if :- - in waterworks i.e. sluice, pipe, pump etc. used for water supply or in declared catchment area.	Max fine \$100	Commissioner of Water; PS - Ministry of Primary Industries
Mining Regulations (Cap 146 S-3)	Offence to pollute Water in race pipe dam or reservoir in respect to which a special site right has been granted to holder of mining lease.	Max fine \$100	Director of Mines & Ministry of Lands and Mineral Resources
Pollution Generally -----			
Pesticides Act 1971 (Cap 157)	Registration of pesticides	Fine \$200 and \$10 per day for infringement	Registrar of Pesticides & Ministry for Primary Industr:
Traffic Regulations 1974 (Cap 176 - S-50)	Offence to drive vehicle from which smoke etc. is emitted likely to cause injury, nuisance or annoyance to any person	Max fine \$100 or imprisonment max 3 months.	Ministry of Infrastruct- ure and Public Utilities
Public Health Act 1935 (Cap 111)	- Board may cause inquiries to be made. Person authorised in writing may enter premises - Power to inspect water and sewerage works. Various powers to abate nuisances :- - Inspection of district to ascertain nuisances.		Central Board of Health (Ministry of Health) Local authorities or Central Board of Health (Ministry of Health)
	Section 56 (e): any accumulation or deposit of any material situated which is offensive to the public or injurious to health may be summarily abated.	Fine \$20 or \$4 per day in default	

Penal Code 1945
(Cap 17)

Various: e.g. common nuisance:-
i.e. causing common injury,
danger or annoyance so as to
interfere with the public (must
be substantial and
unreasonable)

Imprisonment 1 year

Director of Public
Prosecutions (Ministry
of Justice)

Dealing with poisonous
substances in negligent manner.

6 months imprisonment
or \$200 fine

Source: Manuel (1990; unpublished. mss) with additions by NEMP
File Name: Lotus 123: Laws

Figure 1: Rainfall Distribution

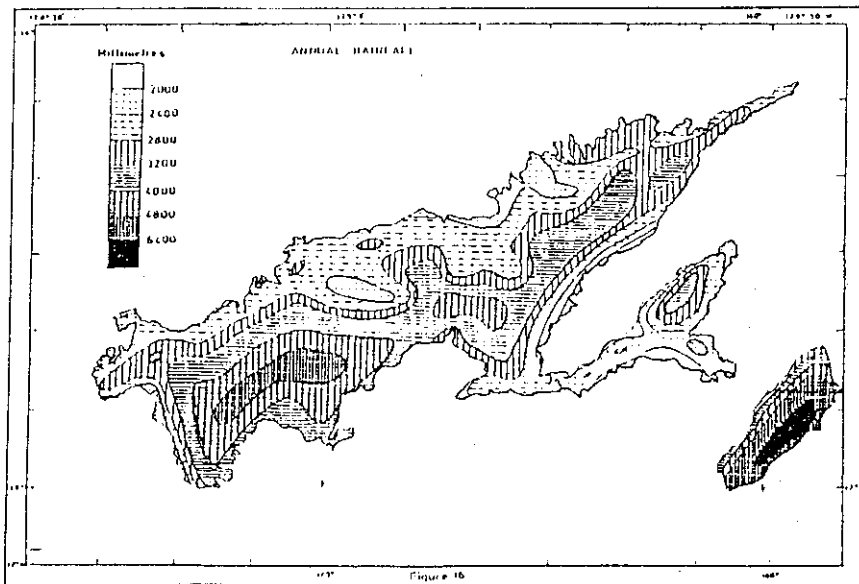
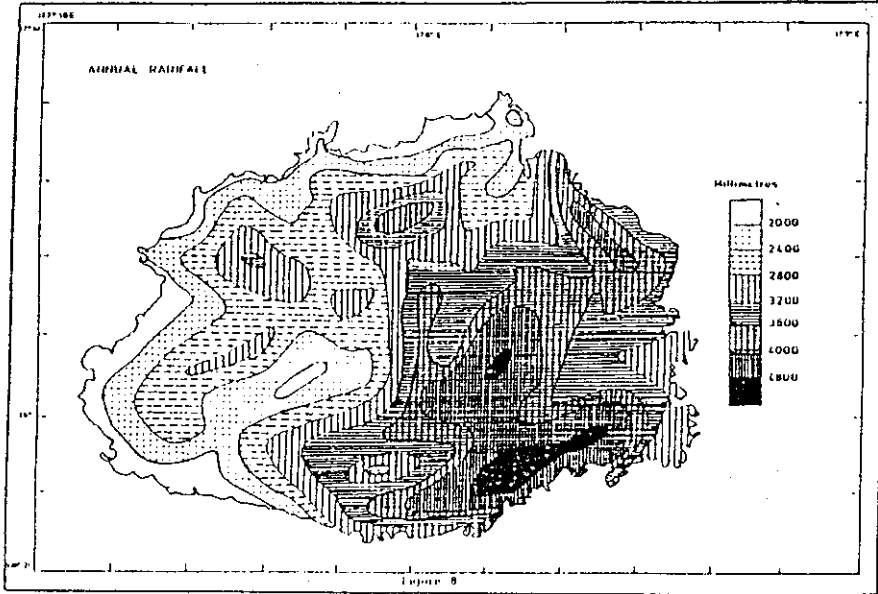
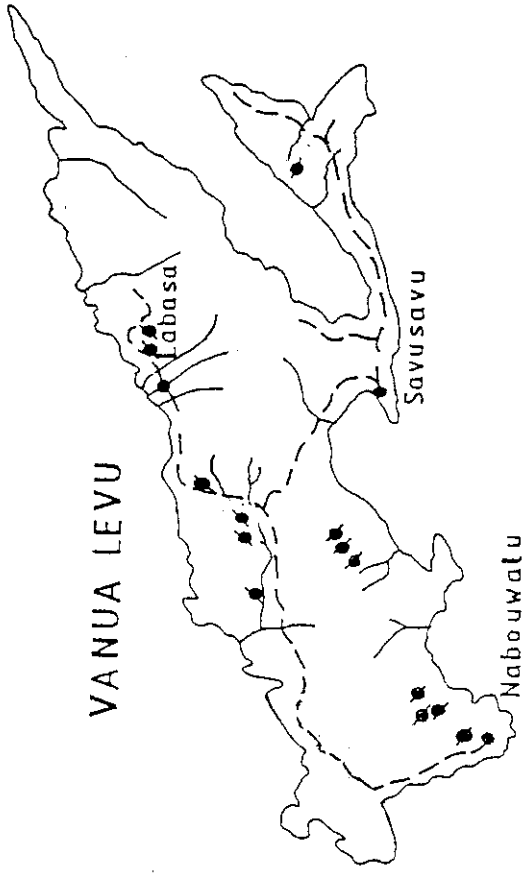
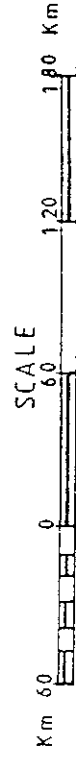
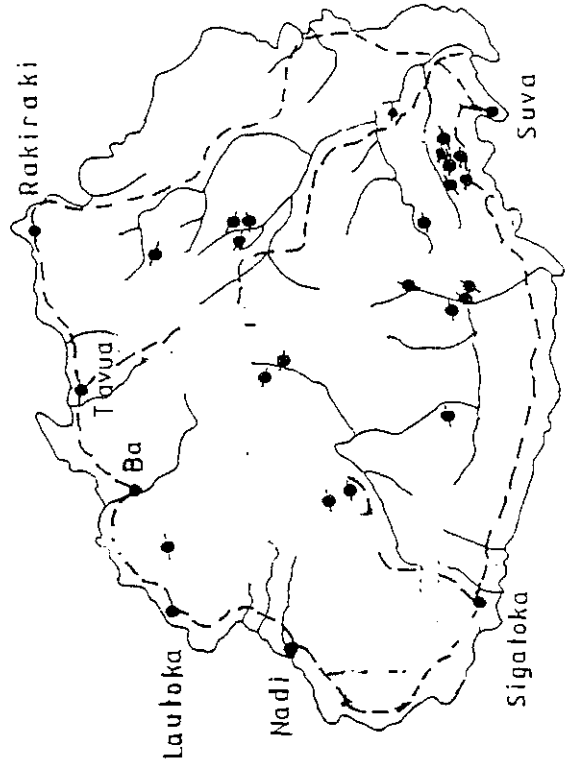


Figure 3: Location of plant species known from a single collection.



VITI LEVU



LEGEND

- Location of plant species known from a single collection
- Main Town
- Main Roads
- Watercourse

Figure 4: Mangrove Distribution

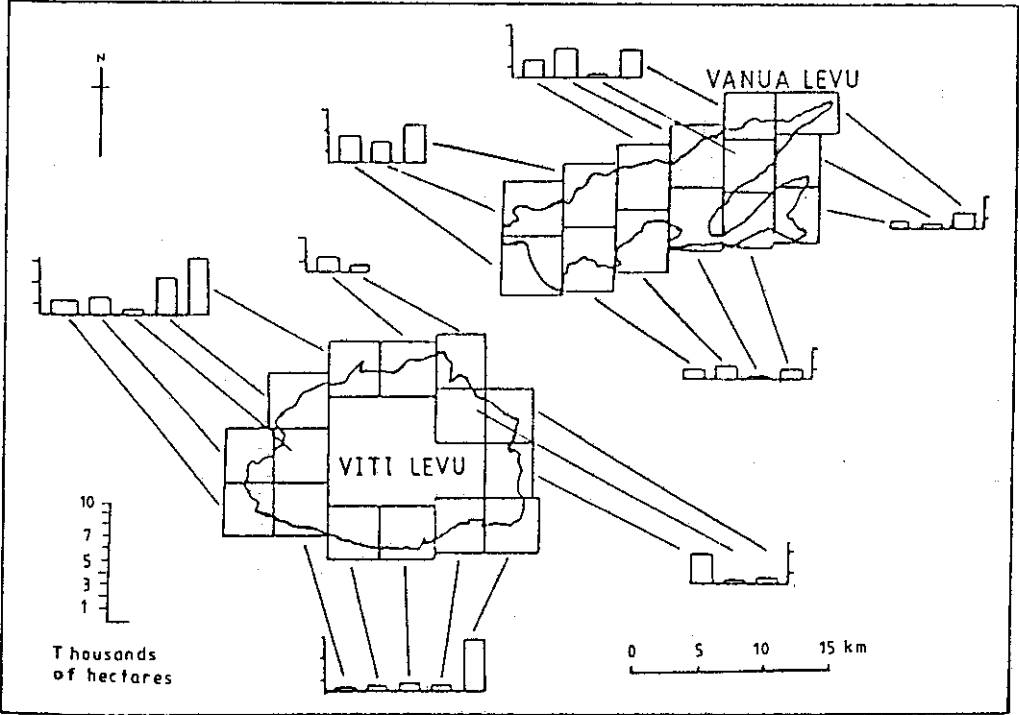


Figure 5

REEF SYSTEM OF FIJI

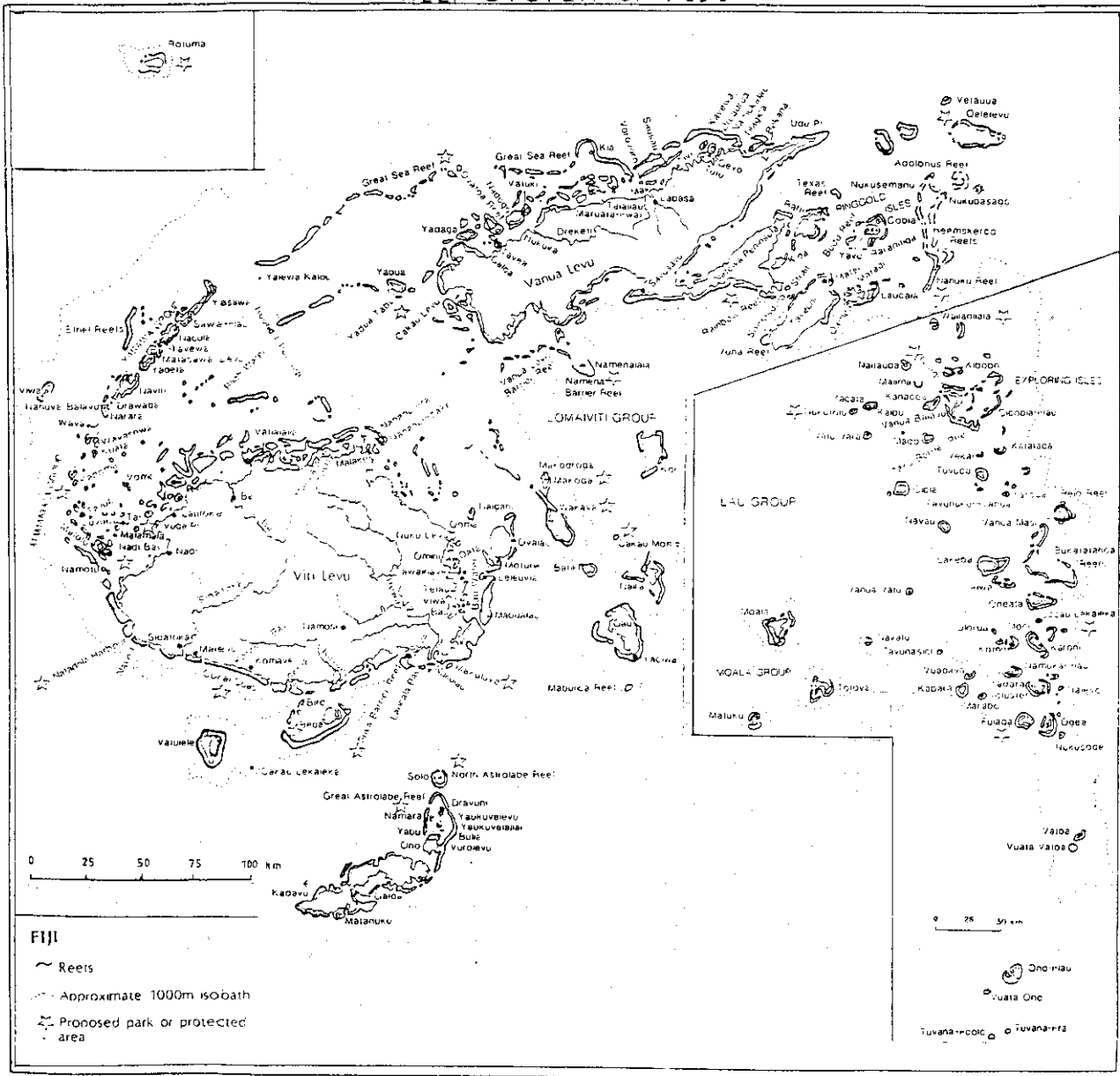


Figure 6

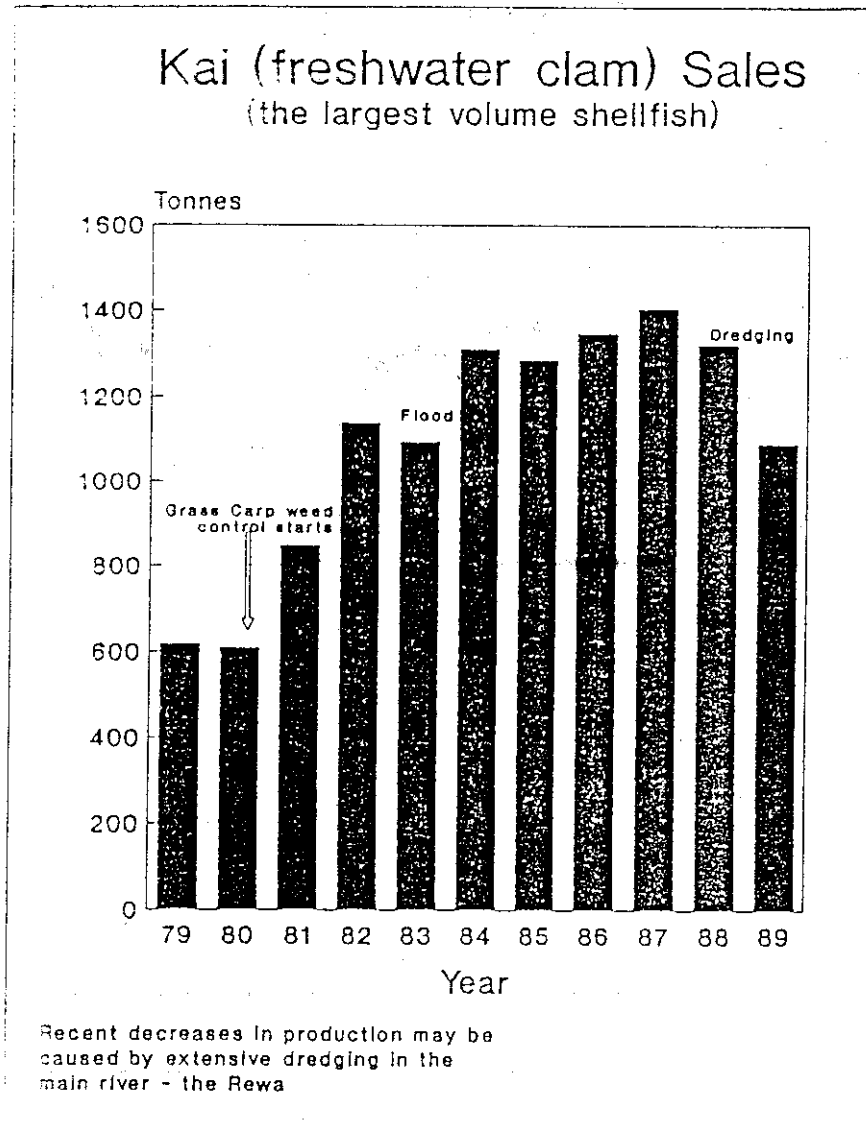


Figure 7

REAL GDP GROWTH
(Annual Percentage Change)

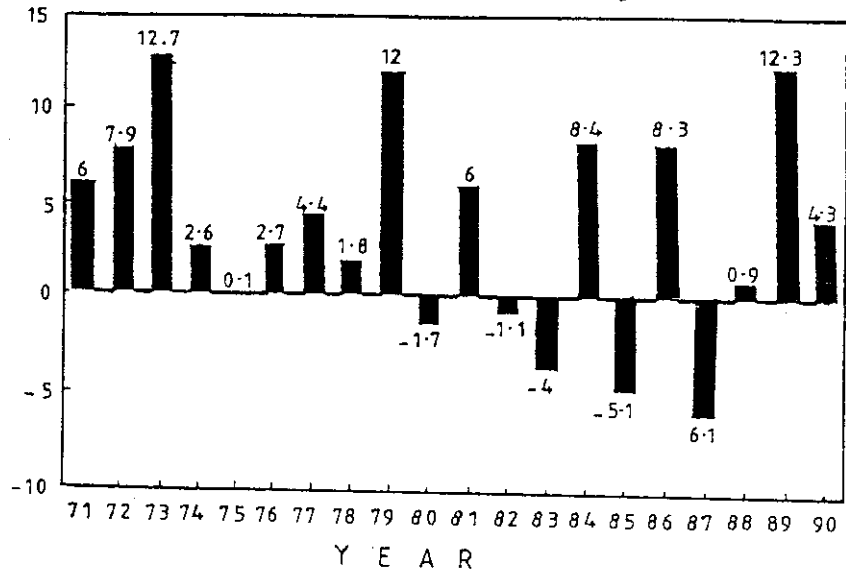


Figure 8

GROWTH IN SUGAR PRODUCTION
(000 Tonnes)

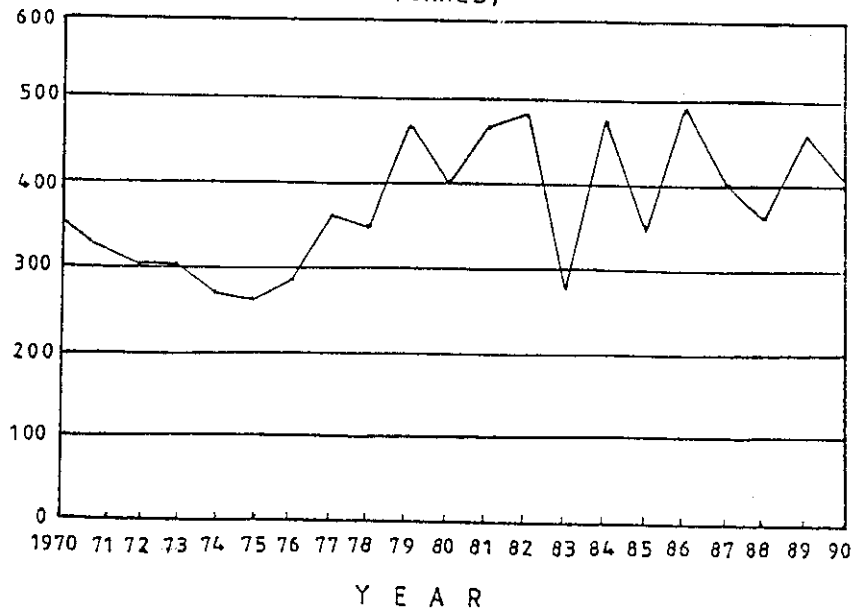


Figure 9

GROSS TOURISM RECEIPTS
(FS Million)

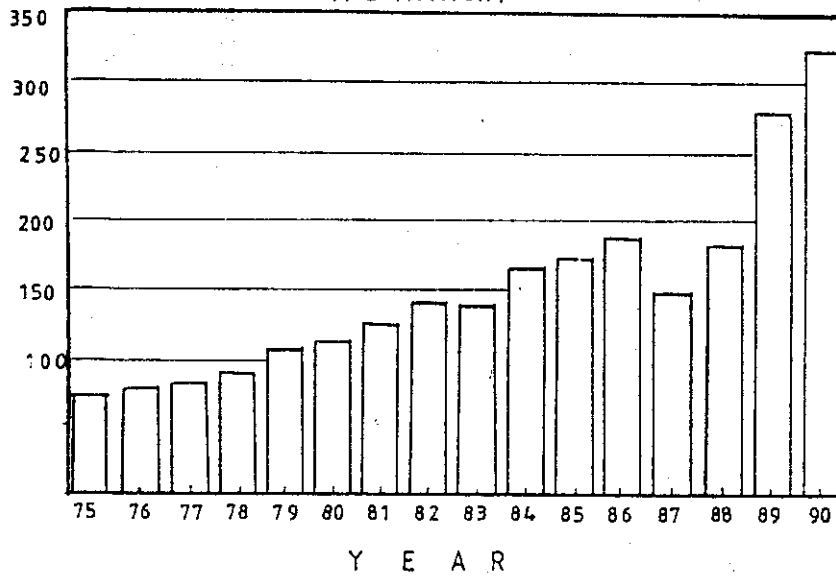


FIGURE 10: AVERAGE WEEKLY PER CAPITA EXPENDITURE BY LOCATION AND REGION

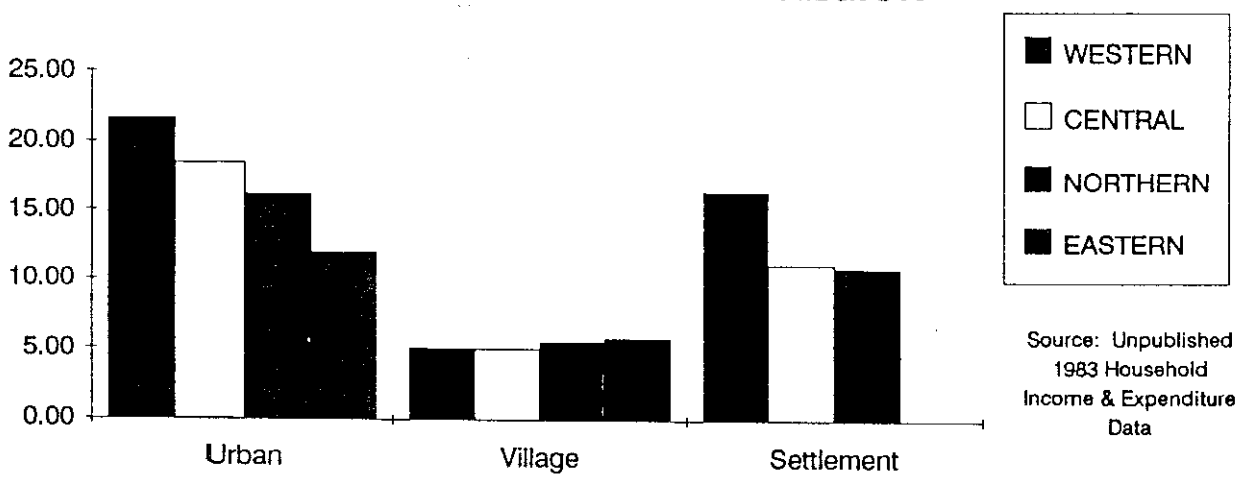


Figure 11: Recent and projected population trends

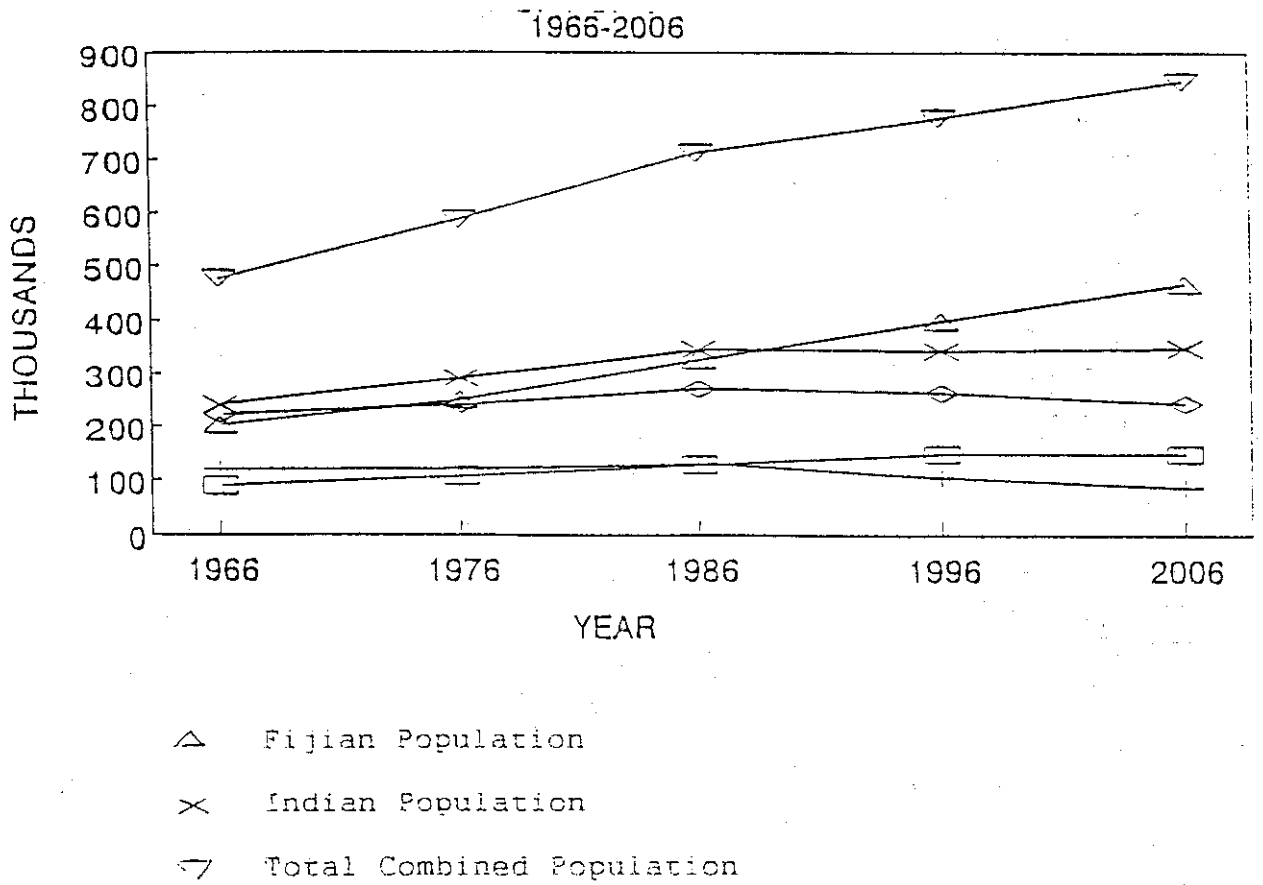


Figure 12: Recent and projected trend in the labour force (15-64 age group)

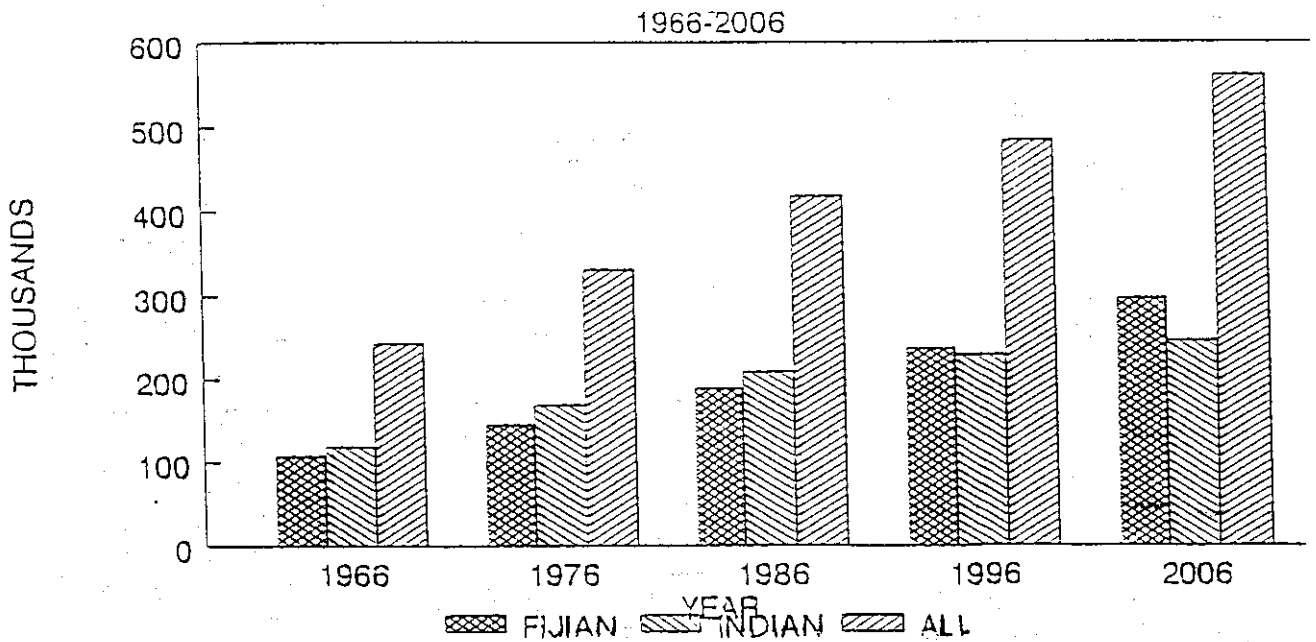


FIGURE 13: AGE-SEX PYRAMIDS BY ETHNIC GROUPS
1991 AND 2011

FIJIAN

INDIAN

TOTAL POPULATION

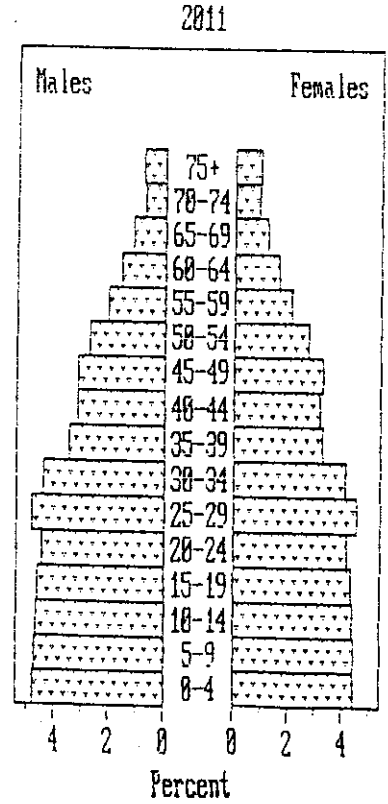
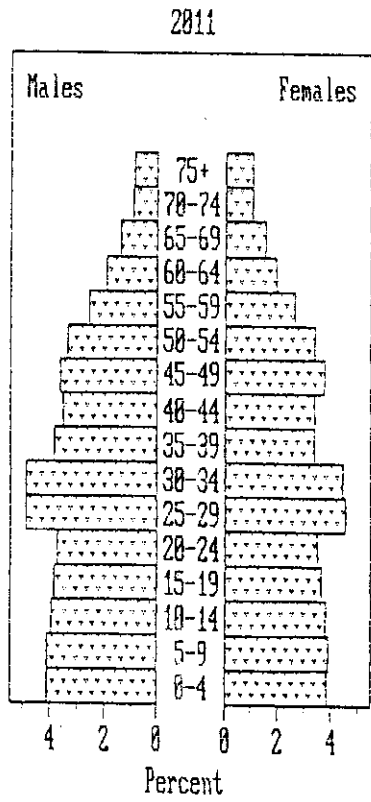
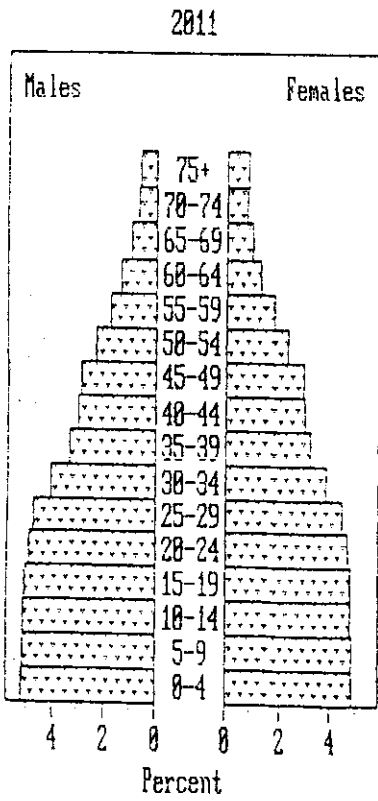
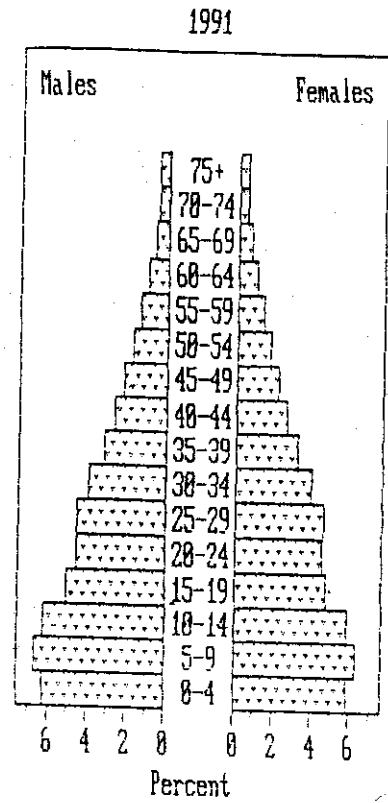
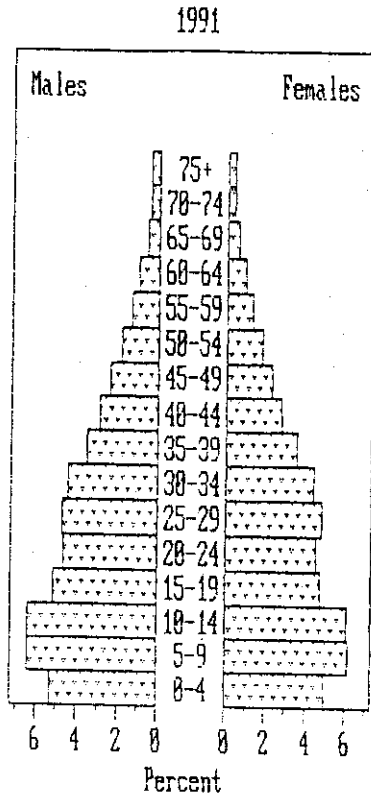
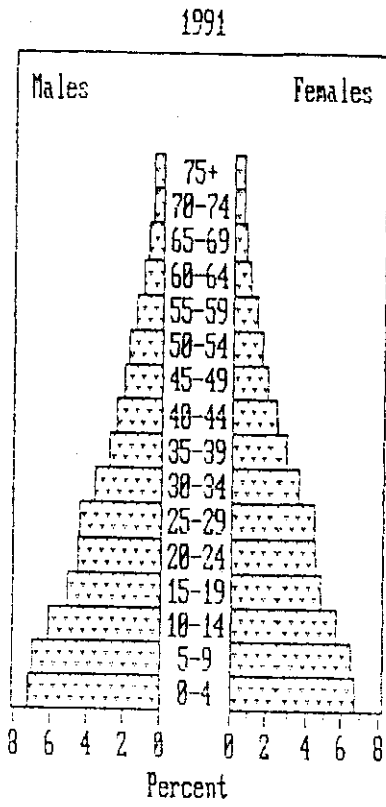


Figure 14

% Total Population by Island Group

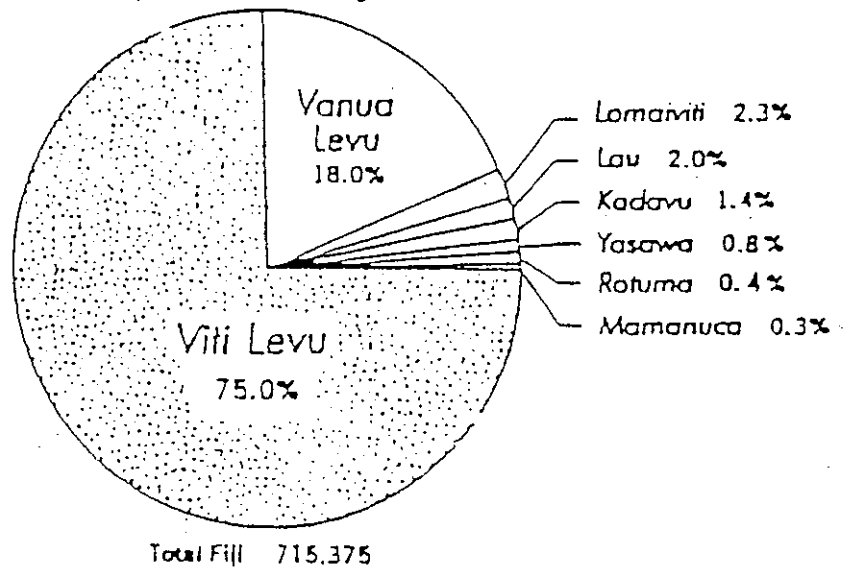


Figure 15: Location of plantation forests

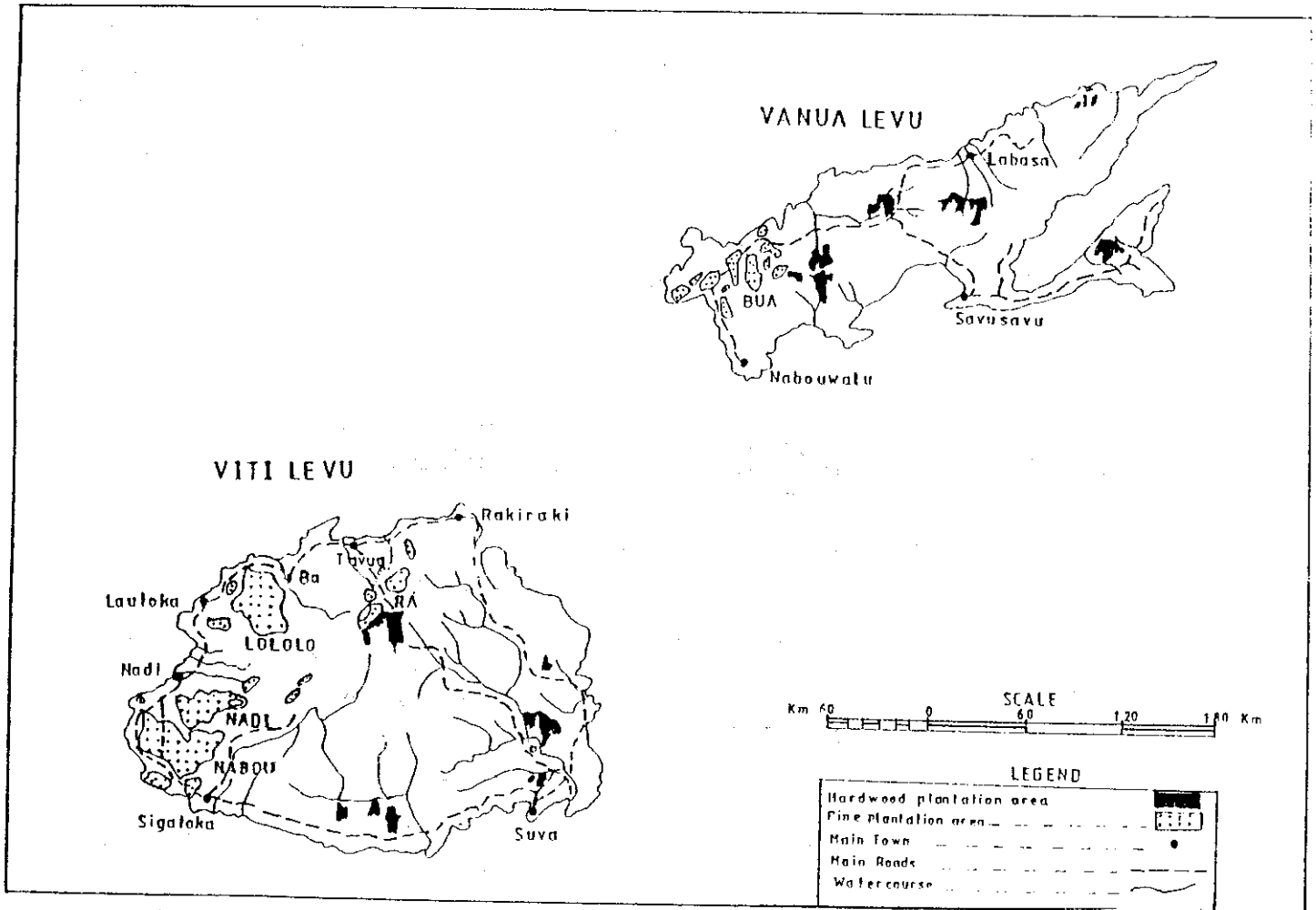
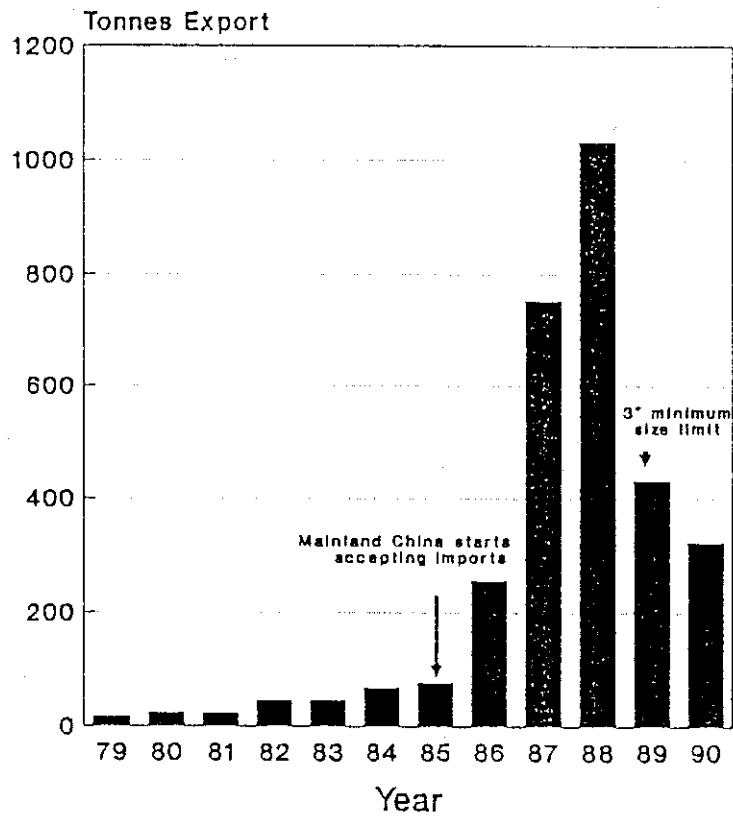


Figure 16

Beche-de-mer Exports A classic "boom and bust" scenario?



(Exports account for almost all the domestic catch. Sandfish is the only species consumed locally)

Figure 17

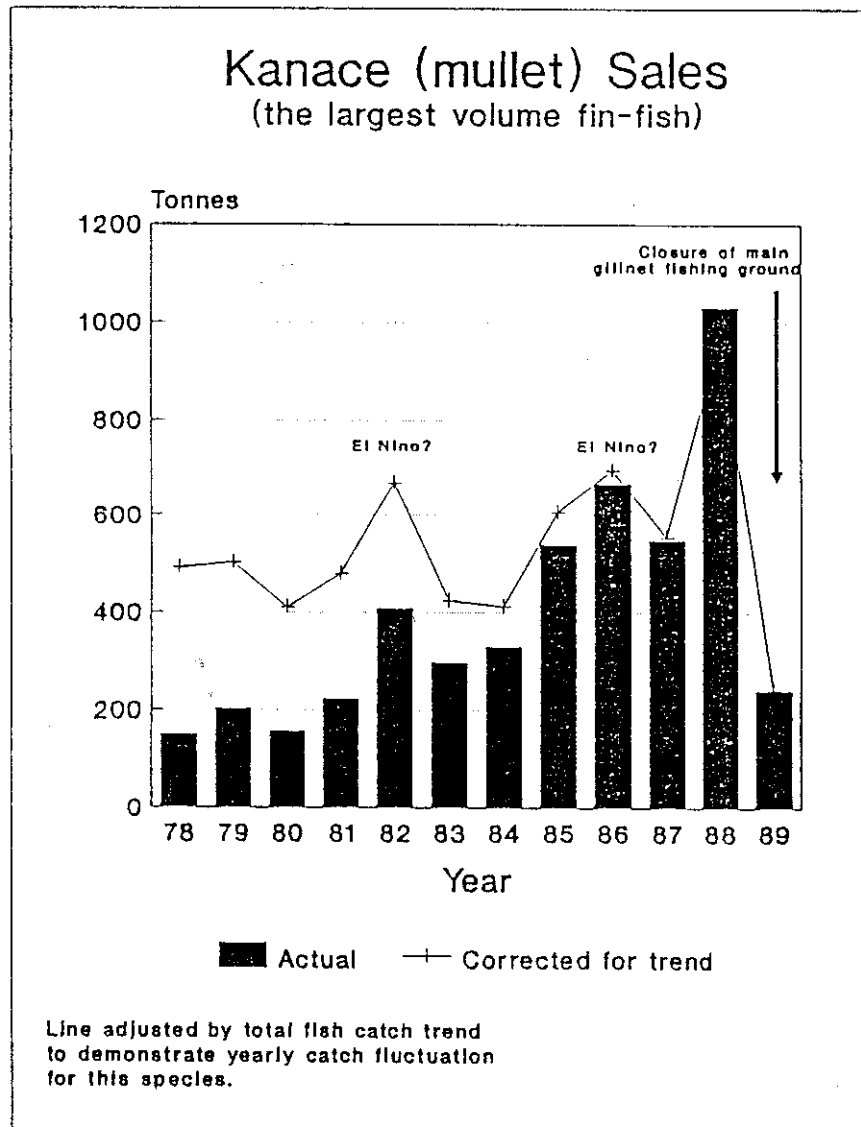


Figure 18

ENERGY SOURCES FIJI 1990

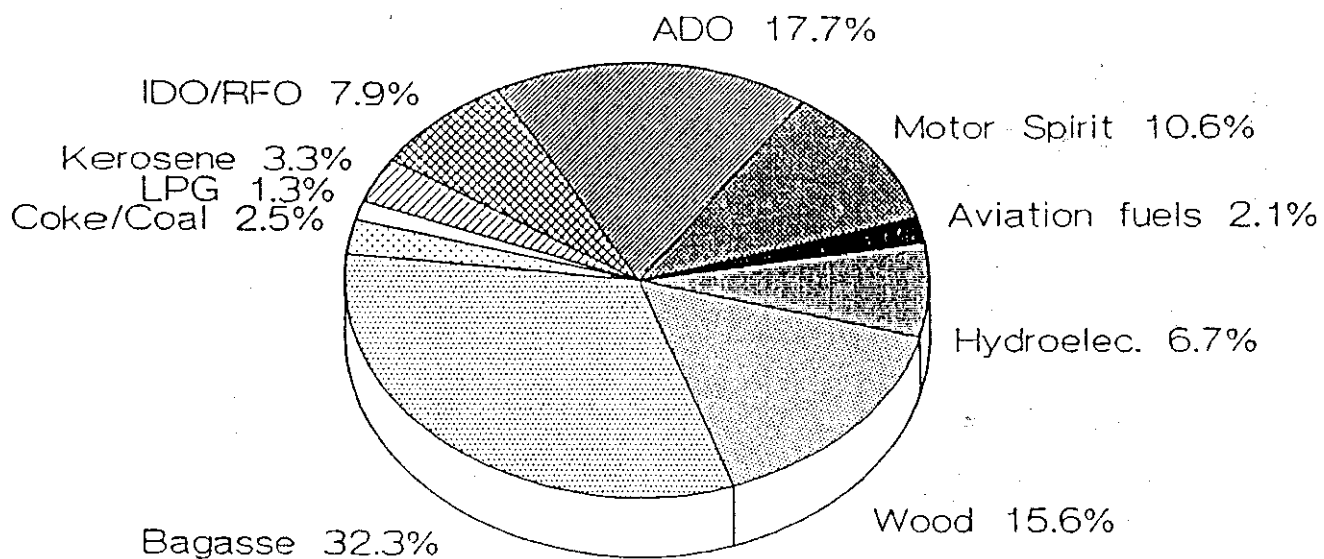


Figure 19

Retained Petroleum Imports Fiji 1983-1990

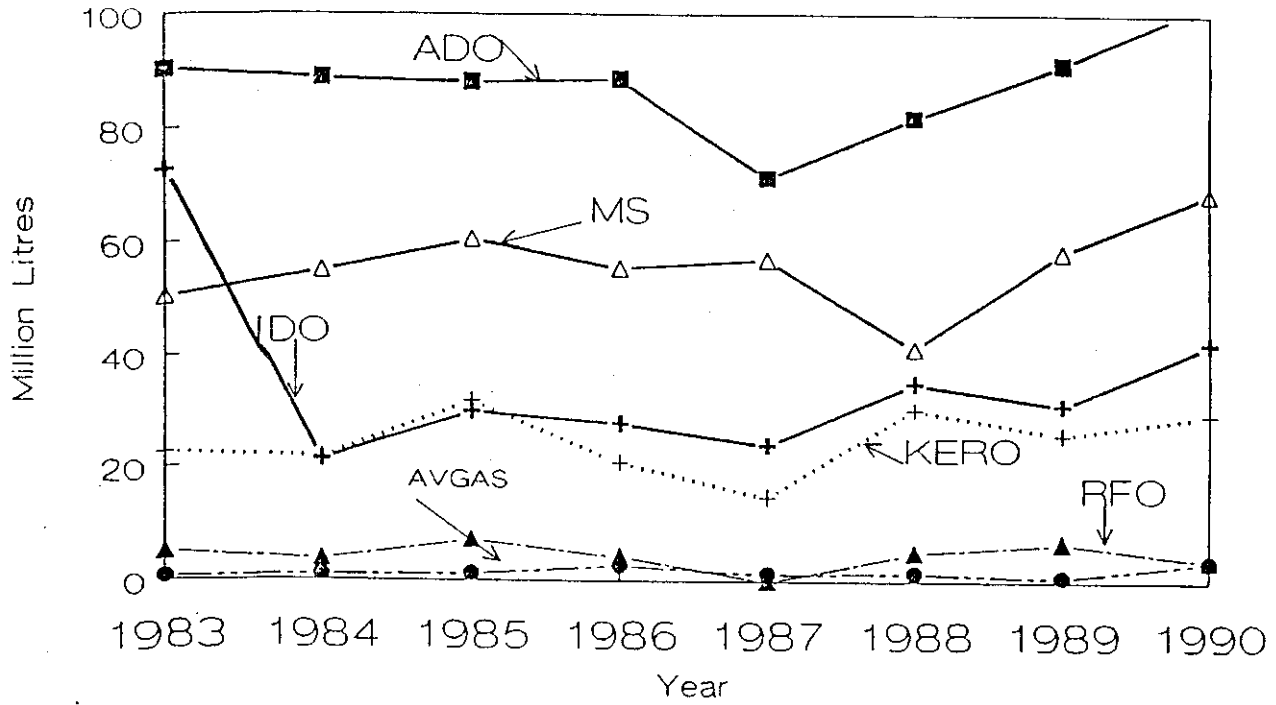


Figure 20

Electricity Production Fiji 1983-1989

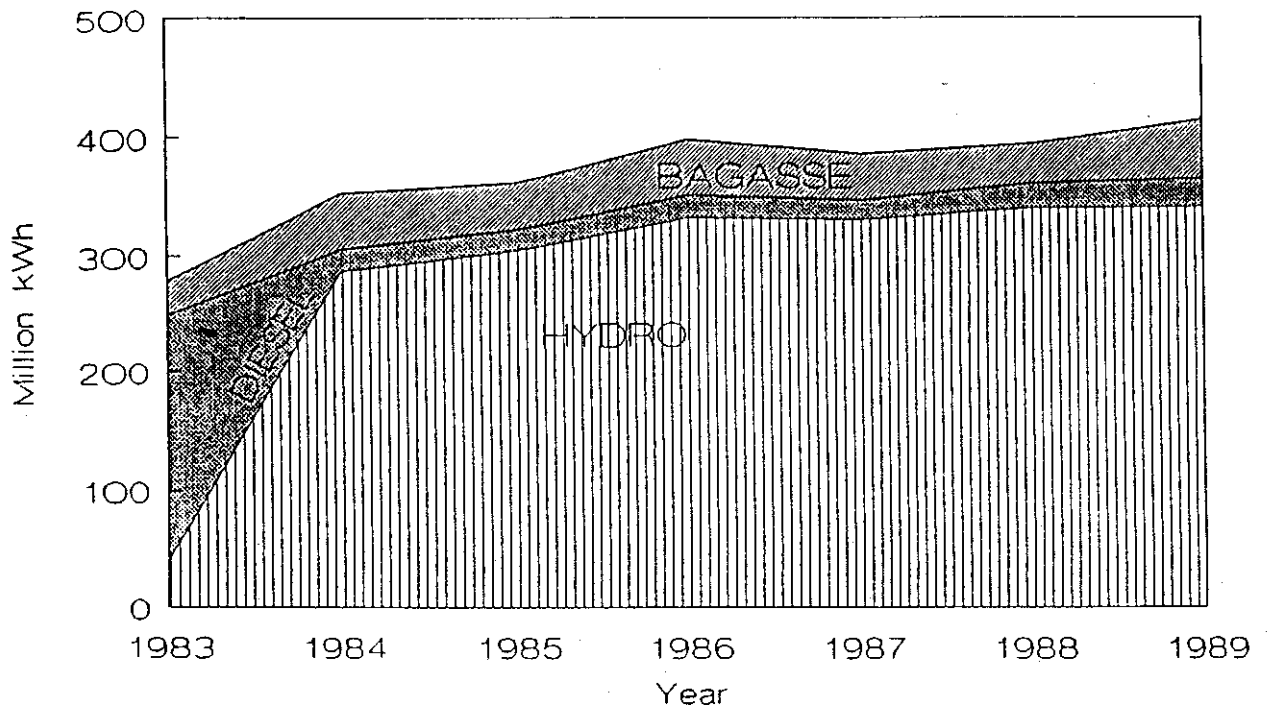
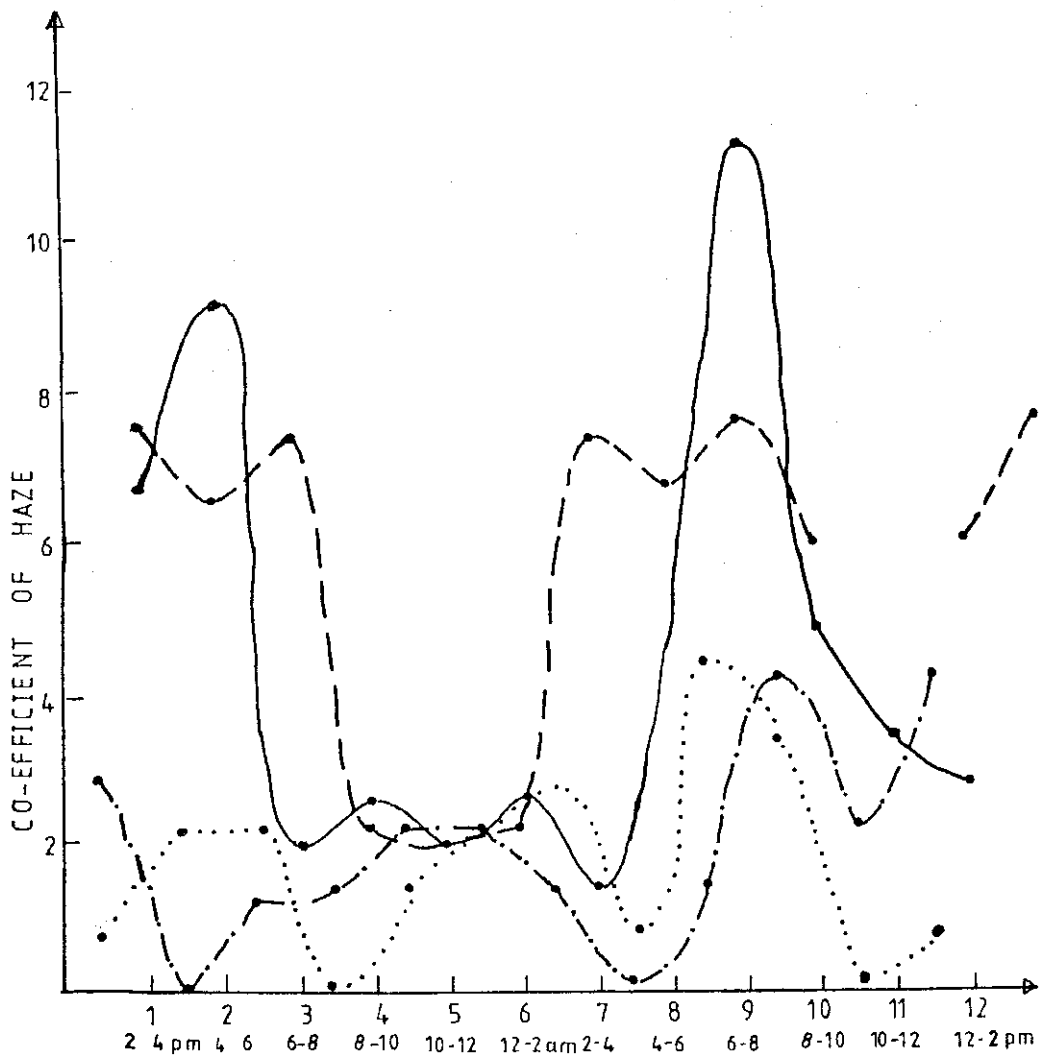


Figure 21: PARTICULATE LEVELS AT VARIOUS SUVA LOCATIONS



KEYS	SITE	ZONE
————	Ministry of Primary Industries beside Bus Terminal	Commercial
- - - -	Health Centre	Commercial
- . - . - .	Samabula	Residential
.	Walu Bay	Industrial

Annex 3: Government Committees concerned with environmental management

- . Land Conservation Board (MPI) Est. 1953.

For many years inactive, this Board has recently been revived. The Board has wide powers to prevent poor agricultural practices.
- . Environmental Management Committee (MHUD) Est. 1980

Provides an advisory and coordinating role to the Director of Town and Country Planning on the environmental implication of development proposals.
- . Mangrove Management Committee (ML&MR) Est. 1983

Advises Director of Lands on development proposals which affect mangroves.
- . Nation Oil Pollution Committee (Marine Department)

Formed in June 1991 as a merging of the Ports Authority Spills Steering Committee and the Oil Pollution Committee. Its purpose is to coordinate the preparations and implementation of a national pollution response plan. Private and public sector representation.
- . Rubbish Dump Committee (Ministry of Housing and Urban Development)

In operation on an ad hoc basis since 1989. Its purpose is to locate an alternative solid waste disposal site so that the existing Lami dump can be closed. Government and local authority representation.
- . Land Information System Council (Ministry of Lands and Mineral Resources)

Established to oversee the development and implementation of a computerised Land Information System within the Department of Lands and Surveys.
- . NLTB Steering Committee

The development of the landowner tourism forest parks at Waikatakata and Bouma has necessitated the formation of committees to oversee the successful implementation of the projects. Government and landowner representation.
- . National Environment Steering Committee (Ministry of Housing and Urban Development)

This committee has been established to oversee the preparation of the National Environment Management Project, as well as coordinating Fiji's involvement in the UN Conference on Environment and Development in 1992 and participation in the World Heritage Convention. High level (Permanent Secretary/ Director) Government and statutory authority representation.

CFC Control Committee (Ministry of Housing and Urban Development)

This Committee will be established to oversee implementation of the Government's commitment under the Montreal Protocol to phase out the use of CFCs (chlorofluorocarbons) in Fiji. Public and private sector representation.
