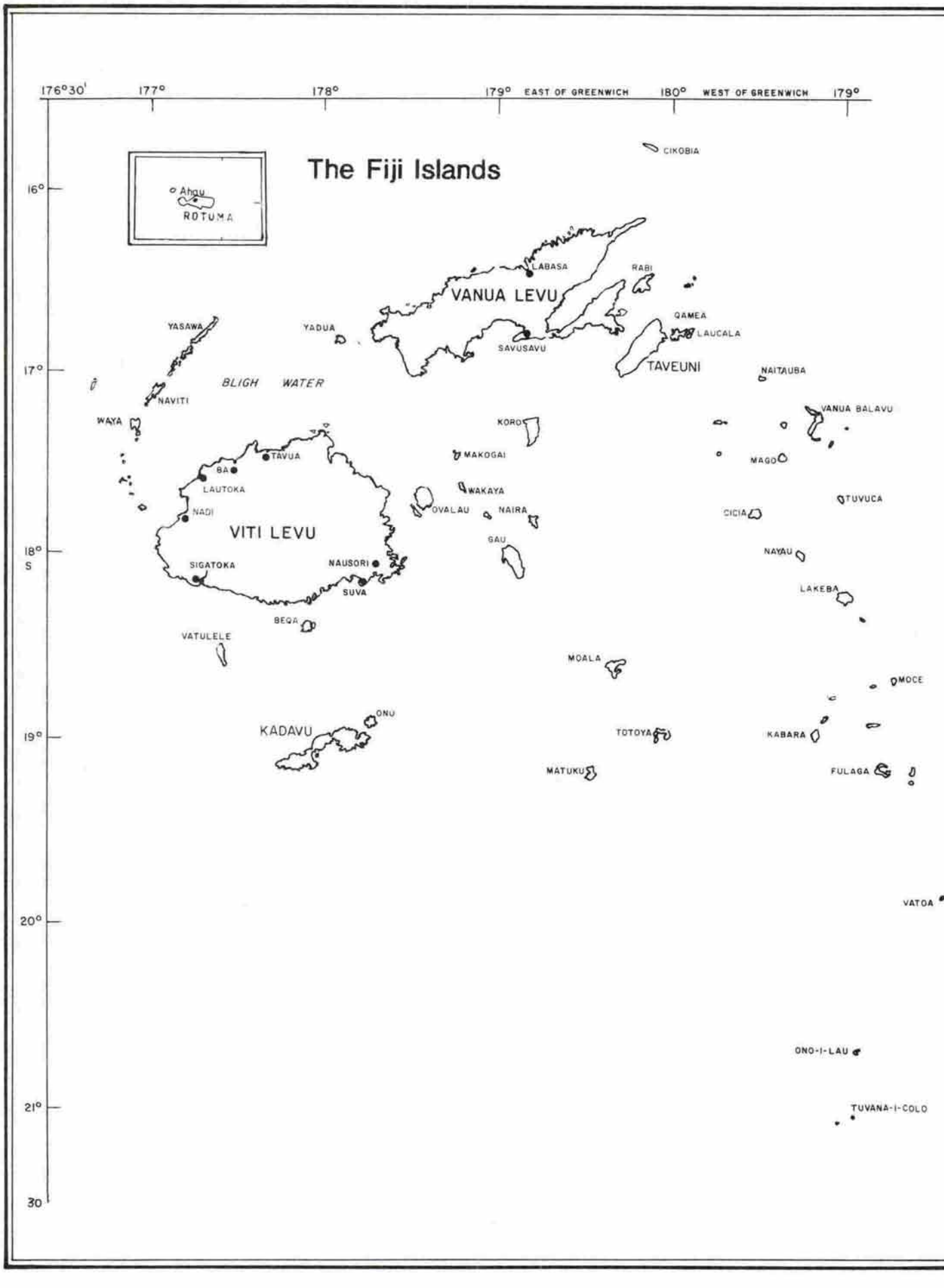
ENVIRONMENT: FIJI

THE NATIONAL STATE OF THE ENVIRONMENT REPORT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176°30'
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Ahau
ROTUMA
CIKOBIA
LABASA
RABI
VANUA LEVU
QAMEA
LAUCALA
SAVUSAVU
TAVEUNI
YADUA
YASAWA
BLIGH WATER
NAITAUBA
NAVITI
VANUA BALAVU
WAYA
KORO
TAVUA
MAKOGAI
MAGO
BA
LAUTOKA
WAKAYA
TUVUCA
NADI
OVALAU
NAIRA
CICIA
VITI LEVU
GAU
NAYAU
SIGATOKA
NAUSORI
SUVA
LAKEBA
BEQA
VATULELE
MOALA
MOCE
ONU
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TOTOYA
KABARA
MATUKU
FULAGA
VATOA
ONO-I-LAU
TUVANA-I-COLO

ENVIRONMENT : FIJI
THE
NATIONAL
STATE OF THE ENVIRONMENT
REPORT

Prepared by IUCN - The World Conservation Union for the National Environment Management Project, as part of technical assistance provided by the Asian Development Bank to the Government of Fiji.

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MARCH, 1992

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FOREWORD

In 1989 the Interim Government agreed to accept a technical assistance grant from the Asian Development Bank to support the Government's own environmental management initiatives. It was agreed that a two year project would be developed which would prepare a National Environment Strategy for Fiji. The technical assistance, known as the National Environment Management Project, subsequently commenced in August 1990. The consultant appointed to undertake the work in collaboration with the Ministry of Housing and Urban Development's Environment Unit is IUCN - The World Conservation Union.

Obviously before we reach the point of being able to produce a National Strategy we must first review our historic and existing situation with respect to environmental quality, natural resources and the way we use them, environmental policy and law and their administration, and so on. This review or "stocktake" is an essential first step in the development of the overall Strategy.

The Government has, in directing the preparation of the National Environment Strategy, recognised that there is a need to convert our stated environmental policies into action. I am mindful of the fact that Fiji's policies and proposed initiatives span at least 16 years, going back to Development Plan 7. This "State of the Environment" report certainly highlights the need to transform our past promises into action.

The report covers all the major issues which should be of concern to us. Perhaps the most important aspect of the report is the fact that it makes us realise to what extent the environment and its resources support virtually every aspect of lives. While Fiji is blessed with an abundance of natural resources relative to many parts of the world and lacks the serious demographic, economic and industrial pressures from which the majority of serious environmental problems originate, we must also be aware of the physical constraints under which we are developing the country. Fiji's small size, young landscape and evolutionary isolation make our natural resources vulnerable to loss or degradation. It is through understanding of these aspects that we can enhance opportunities for development based on the sustainable utilisation of our environmental resources.

That we are currently not operating on such a sustainable basis in many areas has been brought to light in the findings of this report. For example, our limited first class arable soils are now almost fully utilised and the increasing use of marginal lands nas led to erosion of valuable top soil. The associated problem of poor catchment management has resulted in declining water quality in some areas and increasing dredging costs to maintain our waterways. Waste disposal is a growing problem. Development pressures are increasing on our limited coastal lands and on nearshore marine resources. In the area of heritage conservation Fiji is sadly lagging behind many of our neighbours and does not have an effective national parks and reserves system.

A major concern is that our present administration and legal capacities are inadequate to deal with current environmental issues, let alone if problems should increase. It is also worrying that some laws are not actually being enforced which could be, such as the regulations controlling vehicle emissions.

Clearly, if our environment and natural resources are to continue to sustain us then we need to manage them efficiently and effectively. In its concluding chapter the report states that Fijian land ownership and customary rights and their future management are central to sustainable development and sound environmental management. In the words of Professor Asesela Ravuvu, in discussing the concept of **vanua:** " the land is the physical or geographical entity of the people, upon which their survival as individuals and as a group depends. It is a major source of life, it provides nourishment, shelter and protection ... and the material basis for belonging."

It is time that we remember that our environmental resources are not commodities to be used and disposed of as we please. They have been passed on to us, in trust, to be managed wisely and conservatively, so that we in turn can pass their benefits on to future generations. That we should do this is both a responsibility and an obligation.

Ratu Ovini Bokini
Minister For Housing and Urban Development

ACKNOWLEDGEMENTS

The State of the Environment Report has been prepared by IUCN -The World Conservation Union, consultants to the Fiji Government as part of technical assistance provided by the Asian Development Bank for the National Environmental Management Project (NEMP). Resource personnel from many ministries, statutory bodies and other agencies assisted with detailed sectoral contributions.

A draft of the report was widely circulated within Government Ministries and comments incorporated into the final report.

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ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
BOD	Biological Oxygen Demand
CFC	Chlorofluorocarbons
CVI	Conservation Value Index
CWM	Colonial War Memorial Hospital
dB	Decibel (measurement of sound pressure)
dBA	A-weighted decibel scale
DEM	Digital Elevation Model
DP9	Development Plan 9
DPK	Dual Purpose Product
DTCP	Department of Town and Country Planning
EEC	European Economic Community
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMC	Environmental Management Committee
EMU	Environmental Management Unit
ESA	Ecologically Sensitive Area
ESCAP	Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organisation
FCOSS	Fiji Council of Social Services
FEA	Fiji Electricity Authority
GIFAP	The International Association of National Trade Associations for Manu - facturers of Agrochemicals
GIS	Geographical Information System
GOF	Government of Fiji
GPS	Global Positioning System
GTZ	German Technical Co-operation
IDO	Industrial Diesel Oil
INR	Institute of Natural Resources, University of the South Pacific
IUCN	The World Conservation Union
L10	The dBA sound level exceeded for 10% of the time
L90	The dBA sound level exceeded for 90% of the time
MHUD	Ministry of Housing and Urban Development
MIPU	Ministry of Infrastructure and Public Utilities
ML & MR	Ministry of Lands and Mineral Resorces
MOF	Ministry of Forestry
MOT	Ministry of Tourism, Civil Aviation and Energy
MMC	Mangrove Management Committee
MPI	Ministry of Primary Industries
MPI & C	Ministry of Primary Industries and Co-operatives
MRD	Department of Mineral Resources
MS	Motor Spirit
MSY	Maximum Sustainable Biological Yield
NW	North West
NEMP	National Environment Management Project
NES	National Environment Strategy
NGO	Non-Government Organisation
NLTB	Native Land Trust Board
OTEC	Ocean Thermal Energy Conversion
PAFCO	Pacific Fishing Company
PAIP	Public Awareness and Information Programme
PFA	Plant Function Attributes
PHC	Primary Health Care
PV	Photovoltaic
RFO	Residual Fuel Oil
SW	South West
SOE	State of the Environment Report
SOPAC	South Pacific Applied Geoscience Commission
SPACHEE	South Pacific Action Committee on Human Ecology and the Environment

SPC	South Pacific Commission
SPC-PPS	South Pacific Commission - 'Plant Protection Service'
SPREP	South Pacific Regional Environment Programme
STA	Secondary Tourism Activities
TA	Technical Assistance
TFR	Total Fertility Rate
TOR	Terms of Reference
UNCED	United Nations Conference on the Environment and Development
UNEP	United Nations Environment Programme
USP	University of the South Pacific

SUMMARY

Population and demography

Fiji's 1986 population of 737,200 at a density of 39.1 persons per square kilometre can be considered modest, but this figure conceals accentuated densities in excess of 170 per square kilometre of arable land. Over 60% of the population resides in rural areas, but urban drift is significant and increasing.

Recent socio-political events have led to considerable emigration particularly of the Indian component of the population. This makes any future population projections uncertain, nonetheless overall growth is expected to be modest. But, there will certainly be a large increase in the potential labour force over the next 20 years.

Natural resource endowment

Fiji is an archipelagic nation consisting of more than 300 islands scattered over 1.3 million square kilometres 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 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. The geology is highly mineralised. One gold mine is in operation and there are good prospects for further gold and copper mining.

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 multiple landslips which can have a major impact on the economy and infrastructure. The predicted climate change and sea level rise could have profound consequences for some urban centres, agriculture and coastal development.

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. On the low-lying, smaller and outer islands where there are no perennial streams, freshwater is a much scarcer resource. 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's vegetation and wildlife are relatively small in number but are of exceptional scientific and genetic interest because of the high proportion of endemic (unique) forms. Their heritage and potential tourism values are greatly underrated. 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 while some ecosystems, such as the beach forest, have virtually disappeared through clearing. Loss of forest is the surest way to lose Fiji's endemic wildlife because the vast majority are unable to survive outside it. The area of remaining indigenous forest is estimated to be 750,000 ha.

The coastal zone is of vital importance. 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 ha. Mangroves sustain marine and coastal ecosystems which support both subsistence and a growing commercial fisheries sector. Unique marine features occur, such as anchialine pools, marine lakes and caves and landscapes of exceptional beauty such as those at Ogea and Vulaga.

Natural resource use and environmental issues

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 borne, are dengue fever and filariasis. Major agricultural developments such as irrigation projects and poor rubbish disposal, both municipal and domestic, can provide breeding grounds for disease vectors.

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 often been poorly planned and controlled. In the older towns and cities there is an accelerating loss of heritage buildings and attractive urban landscapes.

The almost complete utilisation of first class arable land determines that the current expansion of agriculture into marginal hill areas and steep lands, will continue and increase. Consequently, even a small increase in the population can be expected to dramatically expand localised land degradation. Some agricultural practices, such as steep land sugar cane and ginger production are not sustainable, they dramatically increase natural erosion rates which are already high. This results in loss of topsoil and sedimentation of rivers and streams. The lack of security of tenure for many farmers who must lease land does not encourage careful husbandry of soil resources, while the Government's institutional land conservation measures have been ineffective. 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.

Deforestation in Fiji is moderate but continuing. Since the mid 1960's, 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 with great success, within existing native forests, with some 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. The inshore fishery is of vital importance to the majority of the population who are coastal dwellers. While it appears in good shape at the moment, management measures must be improved if this fishery is to be maintained. Traditional fishing rights 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 of good standard, although Ba town is a recent 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 some 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 benefited greatly from the commissioning of the hydro-electricity from Monasavu Dam. Industrial diesel oil imports dropped by two thirds, saving $170 million between 1983 - 1990. 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'.

Patterns of economic development

The Interim Government has introduced new directions in economic development to achieve improved standards of living. It is deregulating the economy with an emphasis on an export-led growth strategy and economic diversification. Nonetheless, from an environmental perspective, the fundamental basis of national development, remains the same. That is, significant elements of the national economy (agriculture, forestry, fisheries, mining and to a large degree tourism) depend on exploitation of the natural resource base. Production from this sector accounted for almost 60% of domestic exports in 1990. This implies that planning for economic development cannot ignore the need to conserve and manage those resources in a sustainable manner.

The Fiji economy is heavily dependent upon international trade and finance. Imports are dominated by food, energy, manufactured goods and chemicals. Importation of automotive fuels is high. Development assistance only represents about 3% of gross domestic product. Income distribution in the community is uneven, with an acknowledged level of poverty.

The current 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.

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 and hazardous waste. Refuse disposal and management of garbage dumps is a national dilemma which requires a firm Government initiative. The implementation of the Anti-Litter Decree is a welcome attention to this conspicuous problem.

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, throughout Government, have been effectively sectoralised rather than being coordinated in an 'across the board' approach.

The Government has become party to a number of international conventions and treaties. In the last three 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 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.

Development of a specific environmental planning function has taken place within the Ministry of Housing and Urban Development. An inter-ministerial 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 Ministry.

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 Cabinet-designated Sigatoka Sand Dunes National Park, a site of international significance, will not be recognised internationally, until it is effectively managed. Unless a system of protected areas is set up quickly, valuable aspects of Fijian heritage, both natural and cultural, will be lost.

The 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 in other countries. But conversely, its small size, young landscape and evolutionary isolation make its natural resources 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 national hazards and human violation. This zone will receive the most conspicuous impacts of global warming.

Fijian landownership and customary rights and their future management are central to sustainable development and sound environmental management. Three approaches need to be undertaken:

- a natural resource survey to accurately identify all elements of the natural heritage
- preparation of a national land use plan derived through both technical land-capability assessment and consensus, based on full community participation
- a major effort to provide a special form of community education 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.

ENVIRONMENTAL RESOURCES

1 POPULATION AND DEMOGRAPHY

1.1 HISTORICAL POPULATION CHANGES

In 1874, the year of Cession, the Fijian population of about 135,000 was 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 gave an official figure of 127,486, of which 114,746 were indigenous Fijians. In subsequent censuses, the Fijian population continued to decline until 1921, when they reached a low 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. One of the factors involved was a decline in Indian fertility.

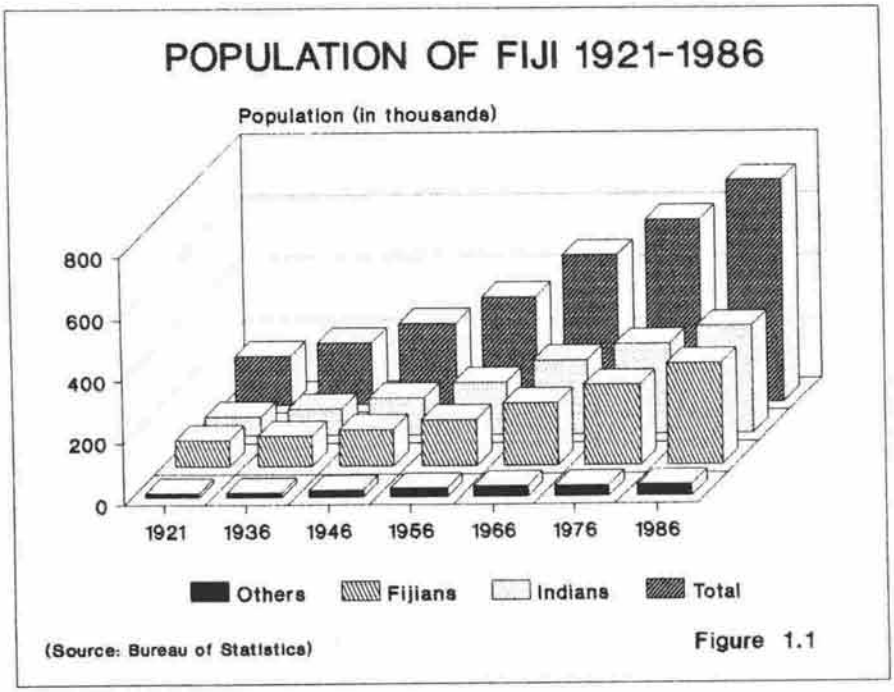


Figure 1.1

The period 1966-1986 saw significant changes in the Fiji population, with a decline in fertility amongst both Indians and Fijians.

1.2 RECENT POPULATION CHANGES

1.2.1 Fertility and family planning

The period 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 to 2.77 children

per woman, 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 started well before 1966 and before the advent of official family planning campaigns in 1962, 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 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.

1.3 FUTURE CHANGES

1.3.1 Migration

Migration, predominantly of Indians following the political upheavals of 1987, has 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.

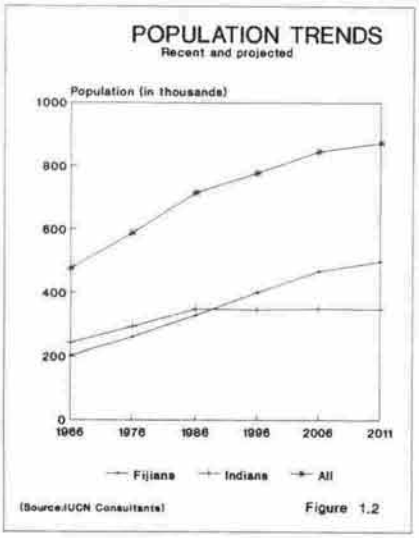


Figure 1.2

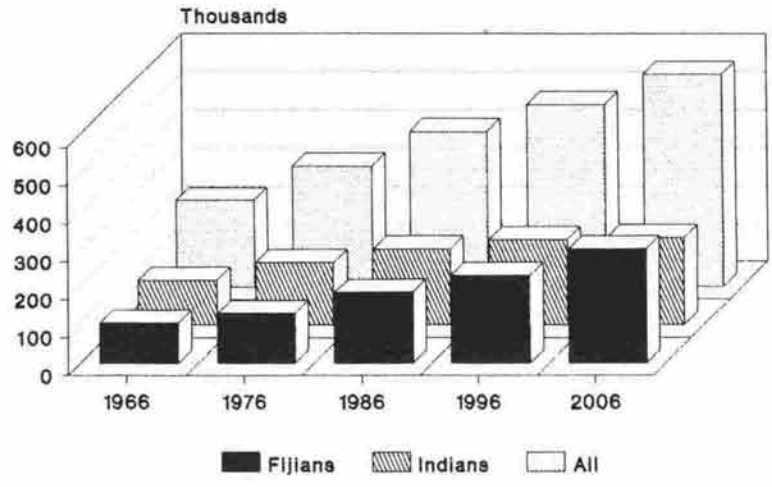
Actual migration numbers, for all ethnic groups, have been accounted for up to the end of 1990 (about 10,000 annually), thereafter a fixed rate is assigned at 50% of the 1989/90 average (which amounts to 5300 annually); a declining rate of fertility is assumed for all, Fijians more gradually to reach 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 projected 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.

1.3.2 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 major increase in the population aged between 15 and 64, because of the compounding effect of even small increases over time.

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, sex-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 in the labour force are likely to be affected not only by the size or the 15-64 age group but also by the increasing proportions who participate, especially women. In Fiji information col-

lected from surveys are notorious for understating women's participation in economic activity.



(Source:IUCN Consultants)

Figure 1.3

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 proportions 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 1.1 Population of Fiji 1921-1986 (in thousands)

Census Year	Fijians %	Indians %	Other %	Total 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.

Dependency burdens reduce in such a situation, where nearly two-thirds of the population are in the 15-64 age group. 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.

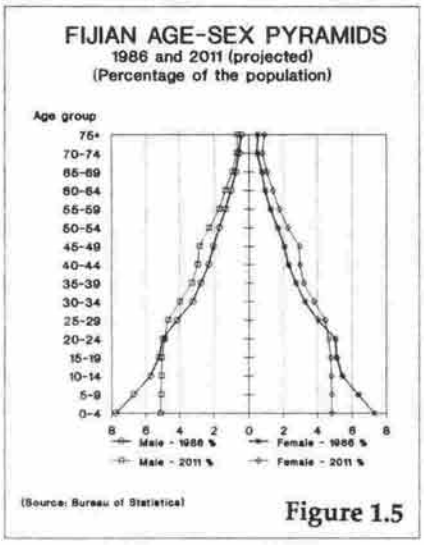
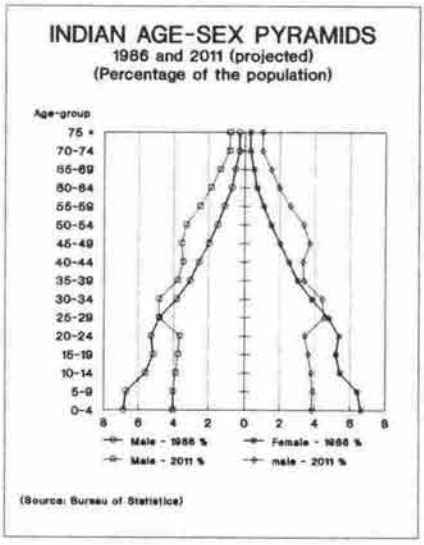
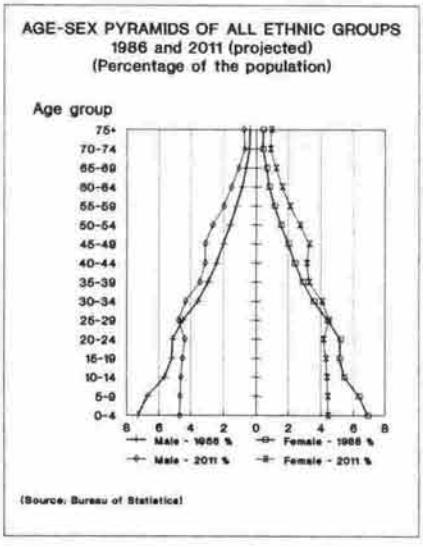


Figure 1.5





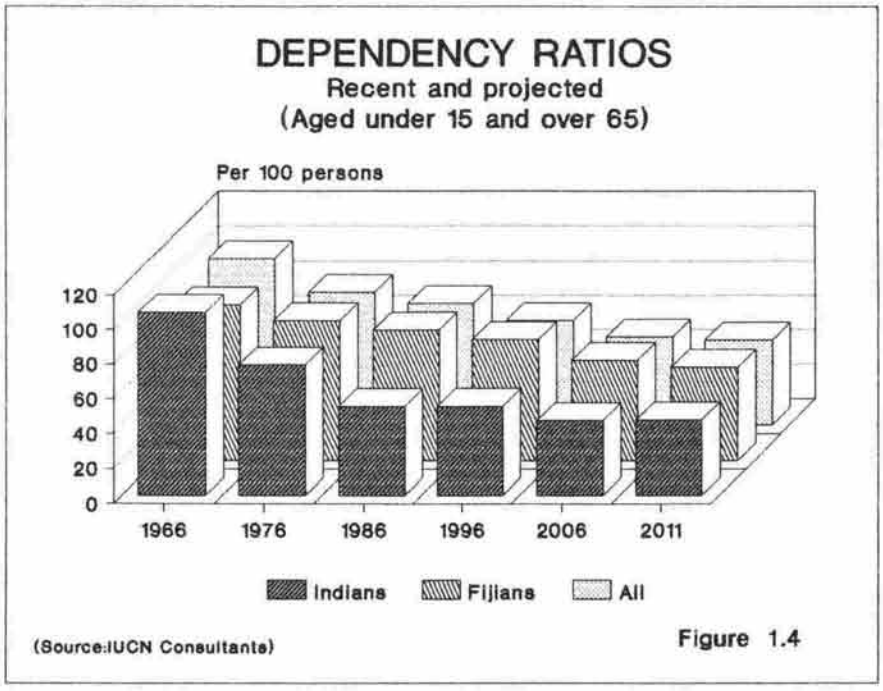


Figure 1.4

Figure 1.5 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.

1.4 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 1.6 illustrates the population distribution.

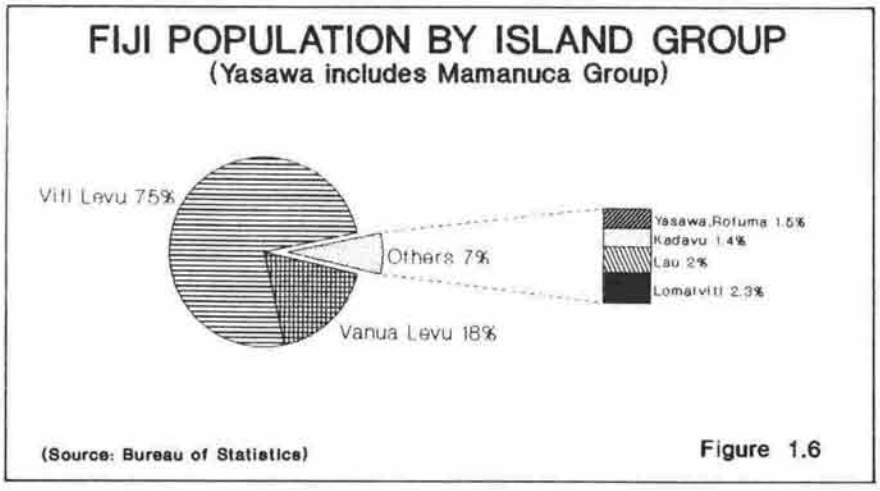


Figure 1.6

Figure 1.7 shows the very uneven population densities amongst the provinces. There were 39.1 persons per km ^{2} during 1986 when averaged over total land area of Fiji, an increase of nearly 14 persons per km ^{2} over the preceeding 20 years. The density increases are particularly high in those provinces which include urban centres and/or are sugar-cane farming areas. Suva City now has 760 more persons per km ^{2} than in 1966. Similarly, owing to increased migration into the urban corridor between Suva and Nausori, Rewa and Naitasiri provinces also show a marked increase 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 because of people moving to Viti Levu. This is most significant from Rotuma. With the forecast population increase, the average number of persons per km ^{2} in Fiji is expected to increase to 45 persons by 2001 and 48 by 2011. While these changes may appear small, their impact on resources could be significant because as mere averages they do not highlight pressures on specific areas.

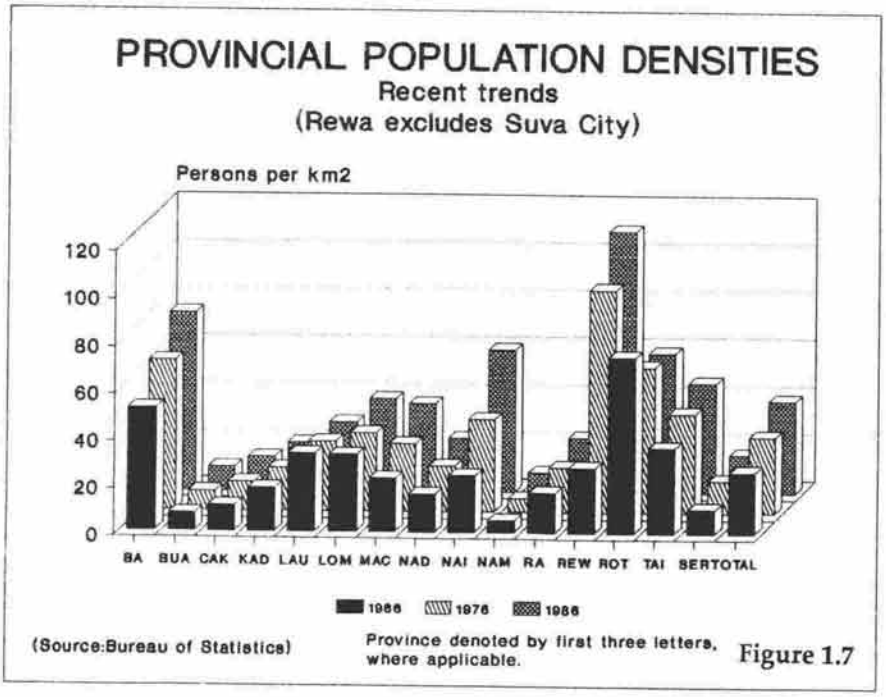


Figure 1.7

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

If densities are calculated per km ^{2} of arable land population pressure on land would certainly appear accentuated at densities in excess of 170 per km ^{2}.

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 to increase. In such a situation even small population increases may 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.

1.5 CONCLUSIONS

Fiji has a modest population size and growth rate. But, 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 with potentially serious implications for the environment.

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 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.

2 CLIMATE, GLOBAL WARMING AND NATURAL EVENTS

2.1 CLIMATE

Fiji enjoys a tropical maritime climate without great extremes of heat or cold.

2.1.1 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, (2.2).

2.1.2 Temperatures

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

With a maritime climate, diurnal and seasonal temperature changes are relatively small. Average temperatures vary only about 3-4 °C between the coldest part of the year (July-August) and the warmest (January-February). Higher humidities in the warmer season (December - March) make conditions noticeably less comfortable.

2.1.3 Rainfall

Although rainfall is highly variable, the average rainfall increases steadily inland from coastal areas. It usually increases plentifully 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.

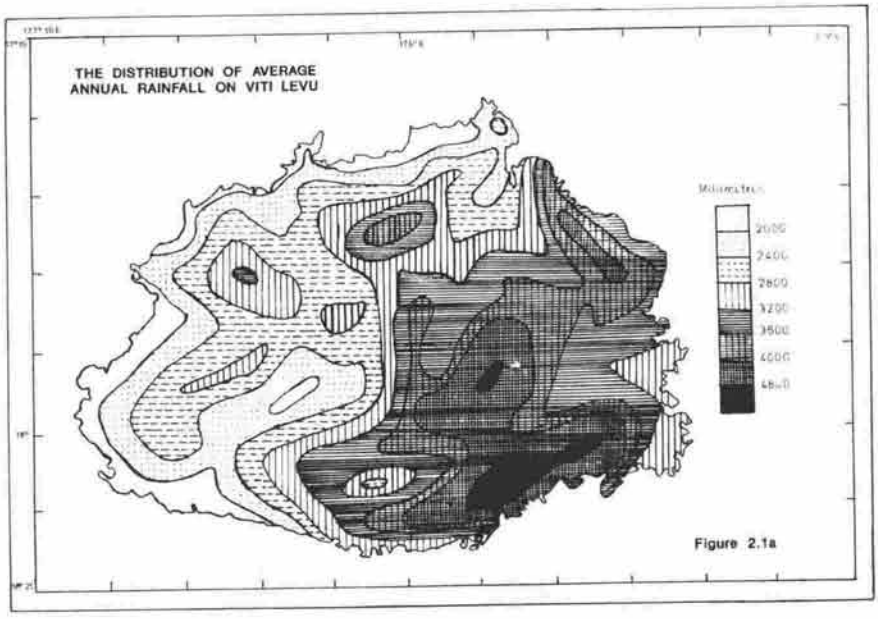


Figure 2.1a

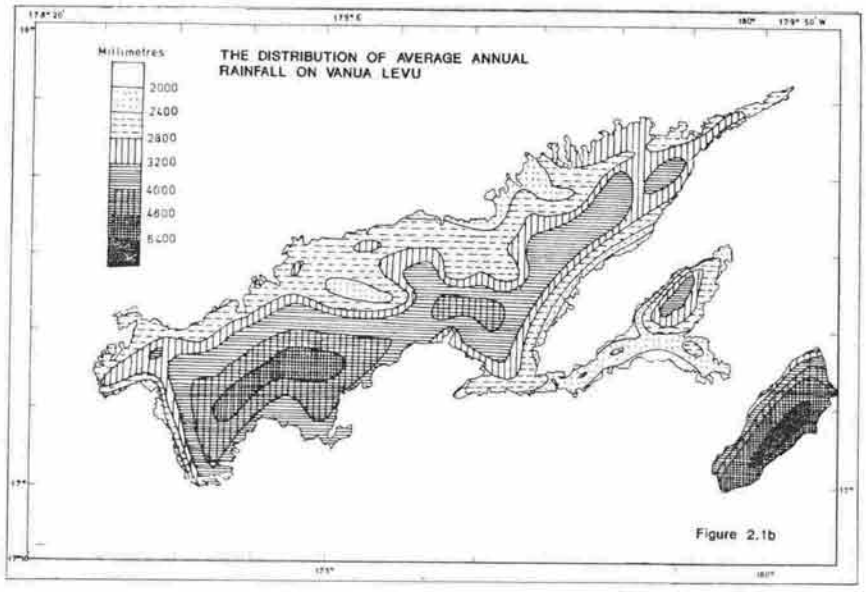


Figure 2.1b

In the drier period, the heaviest rainfalls occur on the windward (southeast) sides of the 'high' islands. On Viti Levu, the Nausori-Suva-Pacific Harbour area has rain on five or six days out of ten, averaging between 1000 and 2000mm for the season. At the same time the sheltered western and northern sides experience much sunny weather, and often drought. Places like Nadi, Lautoka, Ba, Rakiraki and Labasa have rain on only about two days out of ten and average on about 300 to 500mm of rain for the half year. The smaller islands usually receive intermediate amounts.

All parts of Fiji normally receive more rain in the warm season. In the wetter half-year (November to April) the wet side of Viti Levu, in the Nausori-Suva-Pacific Harbour area, may experience rain on seven or eight days out of ten, with a seasonal rainfall average some 1800 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 less than the 'wet' side.

Because of the great variability of rainfall in the region, averages have little value as indicators of the actual rainfall regime.

2.2 CLIMATIC EXTREMES AND DISASTER

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

Flooding is 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.

2.2.1 Cyclones

Fiji lies in the area frequently 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.

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Most parts of Fiji experience the nearby passage of a tropical cyclone (within 70 km) some two or three times per decade. Not all have destructive intensity when 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 strike Fiji from the northwest quadrant with the remainder 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 most affected.

2.2.2 Storm surge

Storm surge accompanies most cyclones in Fiji. Table 2.1 summarises the available information on the occurrence of surge in cyclones since 1972. Historical data on storm surge in Fiji are not very reliable. The extreme within the last two decades is three to four metres.

Table 2.1: 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, Beqa
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

* No estimates available but surge known to have occurred.

Source: Fiji Meteorological Service

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

2.2.3 Earthquakes

The Fiji Group lies in one of the most seismically active areas of the world. Earthquakes have been recorded from 1850 to the present and are the major land-based hazard in Fiji.

Several major earthquakes have been recorded, the most significant of which were in Kadavu (1850), Suva (1953) and Taveuni (1979), with another eight registered since 1850. The 1953 Suva earthquake was the most destructive in Fiji's history, with accompanying landslides and tsunami causing

considerable damage in the Suva, Nausori and Navua areas.

An analysis of the earthquakes recorded in Fiji to date indicates fluctuations between periods of relatively low and high seismic activity. Although estimates are based on limited information it appears that active periods of about 10 years are followed by 20 years of inactivity.

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

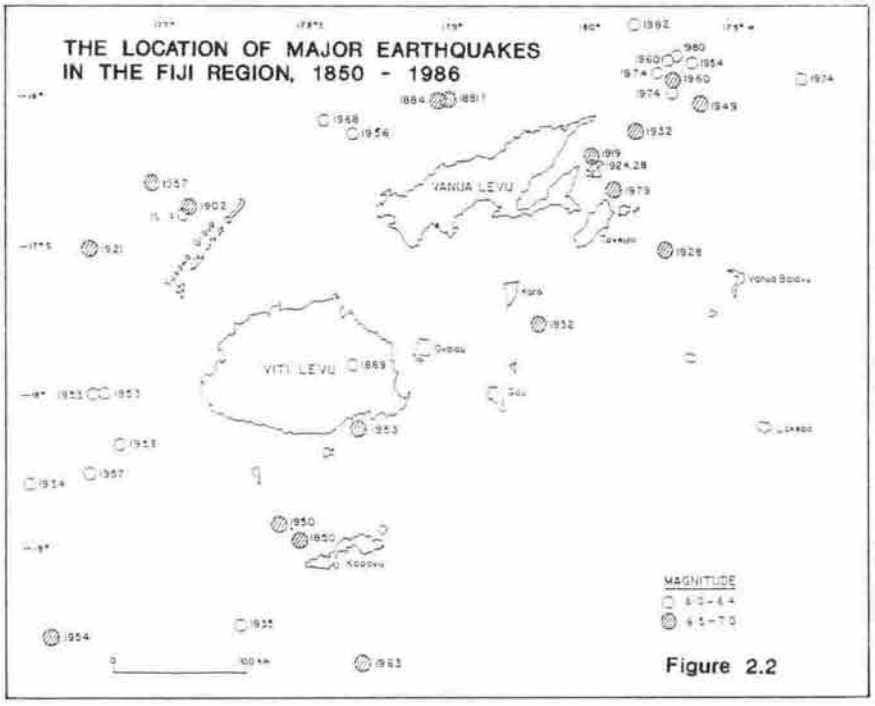


Figure 2.2

The northeast zone is the most active with the largest earthquakes (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.

2.2.4 Tsunamis

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, slumping 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 less than 0.5m wave height.

...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.

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, with only one of them in the last 106 years, there is a possibility of a major tsunami being generated by any major local earthquake.

2.2.5 Landslides

Unwise agricultural practices, road building, logging and mining can greatly increase the hazard if the landslip-prone characteristics of the terrain are not respected.

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, which may or may not be associated with cyclones, can cause multiple landslides in highly localised areas. These may occur irrespective of landuse. 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 570,000m ^{3} of soil, or 90 tonnes/ha over the catchment as a whole.

2.3 CONSEQUENCES OF FIJI'S CLIMATE

Climate has environmental consequences which are normally overlooked. At the regional level it largely controls the nature and distribution of vegetation and thus, the potential for commercial crops and livestock. Its overriding effect is on the population as a whole, for 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.

Extremes of weather may cause disaster. The magnitude of most disasters depends not on the severity of the extreme event alone but to a large 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 long-term preventive approach to atmospheric and other hazards rather than relying on costly 'event-by-event', or 'fire-fighting' mode of disaster management.

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

2.4 GLOBAL WARMING - IMPLICATIONS FOR FIJI

2.4.1 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.

...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 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 (° 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 also risen, by 0.5-1.0 °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 may be occuring at a much faster rate than the natural climatic changes of the past.

2.4.2 A likely scenario

Even if emissions of greenhouse gases ceased now, 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.

2.5 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 (UNEP 1990) 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 2.2, while their impact at the community or local level is illustrated by the likely scenario at Labasa, Vanua Levu, see Box 2.1.

Table 2.2 Effects of global warming (UNEP 1990)

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 drought in some areas
- loss of agricultural land
- changes in fishing grounds
- rising power demands for air-conditioning
- domestic and industrial water supply problems
- changes 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.

The Labasa area, northern Vanua Levu, showing the 1.5m and the 3.5m shorelines.

Box 2.1

LABASA -- THE EFFECTS OF SEA LEVEL RISE

Labasa is the largest town on Vanua Levu and is important primarily as a service centre for the sugar industry. Were sea levels to rise there would be major losses of prime sugar cane land and major siltation of the three river valleys, Wailevu, Qawa and Labasa.

Much of Labasa town would be inundated by a 1.0m rise in sea level and would be virtually uninhabitable because of the increase in frequency and severity of floods.

3 LAND

3.1 AREA

Fiji consists of approximately 300 islands exceeding one half hectare in area, together comprising approximately 18,300 km ^{2} with many smaller islands or islets which are little more than exposed reefs or cays. Viti Levu (10,544 km ^{2}) and Vanua Levu (5,535 km ^{2}) comprise 88 percent of the total land area.

3.2 GEOLOGY

Fiji's 300+ islands form part of a complex arc 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 of greater age.

3.3 TOPOGRAPHY

Physical relief is an important environmental factor for it is an important determinant of 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 steepland (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. The steep slopes also lead to frequent landslides following heavy rain (see 2.2.5).

3.4 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:

(i) soils developed on the relatively flat areas derived from river or marine deposition - approximately 15% of the land surface.
(ii) soils developed on rolling to hilly land -approximately 20% of the land surface.
(iii) 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 plateaus.

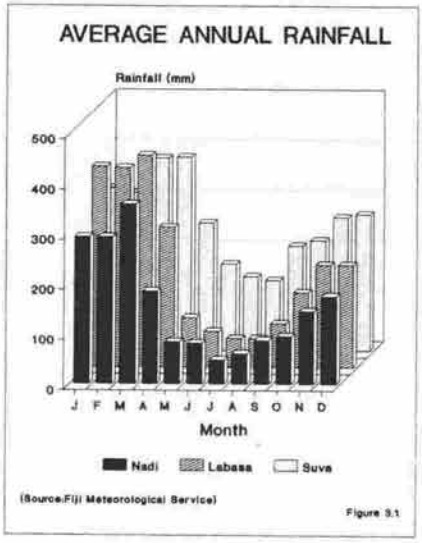
The steep slopes lead to frequent landslides following heavy rain.

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.

3.5 CLIMATIC INFLUENCES

Climatic influences on landform and agricultural potential can be profound. From an erosion perspective the most important climatic factors are the wind and rainfall. (Chapter 2.). 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 (ET_{30} greater than 500/yr) for the whole of Fiji (see 2.2.5).

Further evidence of the rainfall intensity is given inFigures 3.2 and 3.3 with the data for maximum monthly rainfall and maximum rainfall in one day, eg, 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.



3.6 LAND USE CAPABILITY

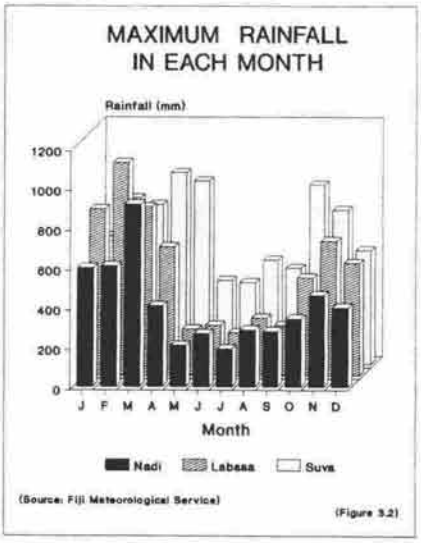
To the casual observer, a flight over Viti Levu or Vanua Levu would reveal large areas of forested, apparently unused land, and to many this gives an impression that Fiji has tremendous potential for agricultural expansion.

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 consid ered 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.
- 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 develop ment but may be of limited use for production forestry.

Based on this land and capability survey, two land use assessments have been reported, Table 3.1



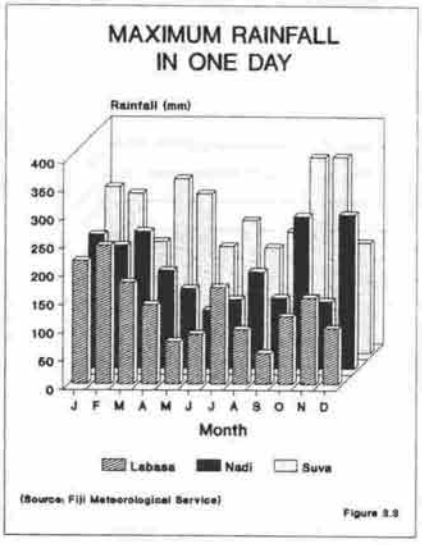


Table 3.1 A Comparison of two land use assessements of Fiji's lands

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)

3.7 CONCLUSIONS

First class arrable land is almost fully-utilised; the remainder will require varying but significant land conservation management if it is to be utilised sustainably.

Fiji's future land based development faces considerable problems. First class arable land is almost fully utilised; the remainder will require varying but significant land conservation management if it is to be utilised sustainably. A relatively large proportion (about 10%) is unsuitable for any form of agriculture or productive forestry.

4 VEGETATION AND WILDLIFE

4.1 FLORA AND VEGETATION

There are probably over 750 endemic species representing between 40 and 50 percent of the native vascular flora.

A preliminary analysis of the Fijian flora has identified 476 indigenous Fijian plants genera of which 10% are endemic (ie found only in Fiji) 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 endemic family (Degeneriaceae) 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 of the genera.

Ferns are an important feature of the native forest being particularly well represented with over 310 species recorded.

4.1.1 Biodiversity and adequacy of the floral inventory

Fiji's flora is well researched in comparison with those of other South Pacific archipelagoes 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 ^{2} although it is likely that at least one thousand herbarium collections per 100 km ^{2} 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.

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.

4.1.2 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 in species numbers. It will, therefore, not be of major international interest for rainforest 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 distributon. 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 facilities.

4.1.2 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 seasonal or monsoon forests of the dry zone. These have been mostly converted to fire climax grassland or scrub communities. Within the dry zone only at higher elevations which receive more rainfall, 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, where the rugged karst terrain has protected fine stands of a special forest type.

4.1.3 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 ^{2}, but no full inventory has yet been undertaken.

4.1.4 Mangroves

Fiji has a considerable area of mangrove (see 6.2) but the community is relatively simple by comparison with those of island and continental south-east 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.

4.2 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. 24 species of terrestrial reptile occur, two snakes, two iguanas, ten geckos and ten skinks. There are also two native species of frog. To these may be added the four species of seasnake and four species of marine turtle which occur in Fiji waters.

Five species are currently known only from Mt Korobababa which is immediately downwind of a highly-polluting factory, the Fiji Industries' cement works.

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%).

4.3 ENDANGERED WILDLIFE AND PLANTS

Figure 4.1

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 others. For in one respect, 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 are widely 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 at least one and possibly 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.

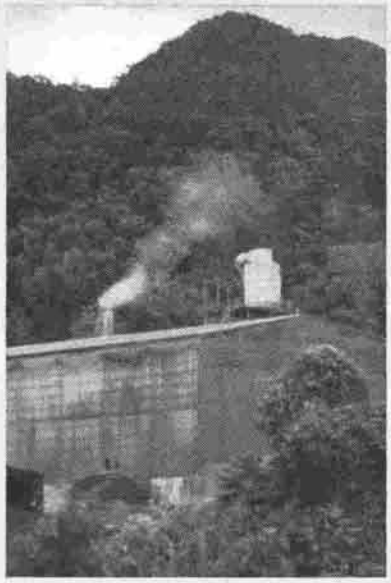
Figure 4.1 shows the localities of some endemic species known from just one or a very limited number of sites, the map is by no means complete. Five species are currently known only from Mt Korobaba which is immediately downwind of a highly polluting factory, the Fiji Industries' cement works. One of these plants, a small tree *Polyalthia angustifolia*, is feared extinct as 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

Box 4.1 *PLANTS ENDEMIC TO MT KOROBABA*

The following plants are currently known only from Mt Korobaba, downwind from the Fiji Industries Cement Factory.

Lindsaea gueriniana	-	a maidenhair fern from the summit.
Lindsaea moorei	-	a maidenhair fern from the ridge near the summit.
Pandanus levuensis	-	a Pandan from mid-height on the mountain. Only 5-8 trees known.
Pteris parhamii	-	a handsome brake fern at 200m on the mountain.
Polyalthia angustifolia	-	a tree 3m or more high, from mid-height on Mt Korobaba. Not seen since 1927. Recent searches have been unsuccessful.



extinct following the arrival of the first settlers. To obtain even an approximate number will require much more extensive archaeological excavation. At present several species are vulnerable as a result of relatively restricted distributions, Table 4.1.

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.

Fiji petrel

4.4 INTRODUCED PLANTS AND ANIMALS

Fiji has suffered less than many other 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

Table 4.1 Single island endemics

Species	Island
Mammals	
Fiji flying fox *Pteralopax acrodonta*	Taveuni
Birds	
Fiji petrel *Pseudobulweria macgillivrayi*	Gau
Whistling dove *Ptilinopus layardi*	Kadavu
Yellow-breasted musk parrot *Prosopeia personata*	Viti Levu
Kadavu fantail *Rhipidura personata*	Kadavu
Ogea flycatcher' *Mayrornis versicolor*	Ogea
Kadavu honeyeater *Xanthotis provocator*	Kadavu
Pink-billed parrotfinch *Erythrura kleinschmidti*	Viti Levu
Reptiles	
Crested iguana[2] *Brachylophus vitiensis*	Yadua Taba
Fiji burrowing snake *Ogmodon vitianus*	Viti Levu
Rotuman gecko *Lepidodactylus gardineri*	Rotuma
Campbell's skink *Emoia campbelli*	Viti Levu
Ono i Lau skink *Leilopisma alazon*	Yanuya,Ono i Lau

Source: IUCN Consultants.

majority have come since European contact. Approximately one thousand exotic plants are established, 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. Other trees such as African Tulip Tree and *Piper aduncum* are also commonly found in forested areas.

The introduced birds and mammals are essentially confined to converted habitats too, though the mongoose, black and brown rats and giant toad 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.

4.5 CONCLUSIONS

...plants and animals can generate considerable national pride and interest; they have heritage values and tourism potential... an awakening to their national values is long overdue.

Fiji's fauna and flora are relatively few in number but are of exceptional scientific interest because of the high proportion of endemic forms - ie those found nowhere else in the world. But plants and wildlife should not be relegated to the interest of specialists alone, they are far more valuable than that. As has been shown in many countries, plants and animals can generate considerable national pride and interest; they have heritage values and tourism potential, while our knowledge of their horticultural and medicinal values is negligible. Fiji's plants and animals need to be elevated out of the ordinary, the every day; an awakening to their national values is long overdue. To this end a commendable initiative is the recent decision by the Government to landscape the new Parliament Buildings with only native Fijian plants.

A few of Fiji's reptiles and birds are rare or have become extinct on the main islands because of the depredation of feral cats and the introduced mongoose but the majority survive on islands free of these scourges. Several other birds are rare for unknown reasons.

What is absolutely clear is that the natural habitat for the vast majority of Fiji's plants and wildlife is forest and that loss of forest is the surest way to lose this valuable heritage. There is an urgent need to greatly raise national and international awareness of this heritage and to undertake detailed fauna and flora surveys to ensure that the full complement of the natural heritage is known.

Box 4.2 *THE MONGOOSE - UNMITIGATED DISASTER*

"I was the fool man who had the landing of the first mongoose in Fiji. It was imported from the West Indies by the Rewa Sugar Refining Company, now defunct....it was brought to control rats, which annually destroyed 5% of the sugar cane.....Now the first noticeable result that the mongoose created was the killing off of practically all the land snakes, which lived in thousands in the cane fields, and whose food was solely rats and mice, devouring the rodents in great numbers". G.T.Barker, 1925

Useless regret, too late. The act was done and the mongoose is here to stay. The mongoose has been responsible for the devastation of the ground-living animals - birds, reptiles, amphibians and even snails. Yet the rats still abound. We know this because these animals still survive in good numbers on islands free of the mongoose.

The mongoose is currently known from five islands, Viti Levu, Vanua Levu, Beqa, Rabe, Kioa. Any further spread of the mongoose will be a fresh disaster.

5 FRESHWATER

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 much scarcer. Generally water is extracted from wells or collected in private or communal tanks. In such situations shortages are common 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.

5.1 SURFACE WATER RESOURCES

5.1.1 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 long 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 ^{2}.

5.1.2 Dams

Two major dams have been constructed in Fiji, both on Viti Levu. The smaller Vaturu Dam with a 2 km ^{2} 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 Monasavu Dam with a 6.7 km ^{2} impoundment provides hydro-electricity and has no water provision function.

A small dam has recently been built on the Wainikavika Creek near Navua. The 0.8 km ^{2} impoundment is shallow and is to provide water for rice irrigation.

5.2 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 groundwater development has been undertaken on islands with frequent water shortages, especially limestone islands. Some islands now rely heavily on groundwater supplies - Rotuma, Vanuabalavu, Lakeba, northern Taveuni. Tourist development in the Yasawas and Mamanucas has also relied to a large extent on groundwater resources.

5.3 CONCLUSIONS

The groundwater resource is fragile and finite, especially on the smaller islands. It is necessary to assess the volume which can safely be abstracted.

Fiji's freshwater resources are relatively plentiful, although there are localised deficiencies. In particular, the heavily populated sugar cane growing areas in the dry zones of both Viti Levu and Vanua Levu which are subject to periodic shortages. More critical but affecting a relatively small proportion of the population are the resources on lowlying islands especially limestone islands where water percolates quickly through the soil and bedrock. In such localities water needs to be husbanded carefully, not only in the interception of rainfall but also in the extraction of ground water.

The groundwater resource is fragile and finite, especially on the smaller islands. It is necessary not only to find effective ways of drawing on it but especially to assess the volume which can safely be abstracted. In small island situations, removal of too much can allow saltwater to intrude and the freshwater lens can be irretrievably fractured and lost. This results in the loss of the freshwater supply.

6 COASTAL RESOURCES

6.1 SIGNIFICANCE OF THE COASTAL ZONE

The coastal zone is of vital importance to Fiji's society and its national development. It brings together an 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.

6.1.1 The maritime setting

Fiji's national waters cover approximately 1.3 million km^2 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 termperatures are always above 20 °C with a summer ocean maximum of about 30 °C and a mean annual variation of about 6 °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.

6.2 MANGROVES

6.2.1 Area of the mangrove resource.

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 irregular, the largest formations are found in deltaic formations at the mouths of some of the larger rivers - Ba, Rewa, Nadi and Labasa (see Figure 6.1).

The underlying structure of the mangrove zonation is relatively simple (4.1.1). Climatic conditions are important. In the dry leeward areas with high seasonal evaporation, hyper-saline mudflats are a characteristic feature which are virtually absent from the wetter, windward mangrove areas.

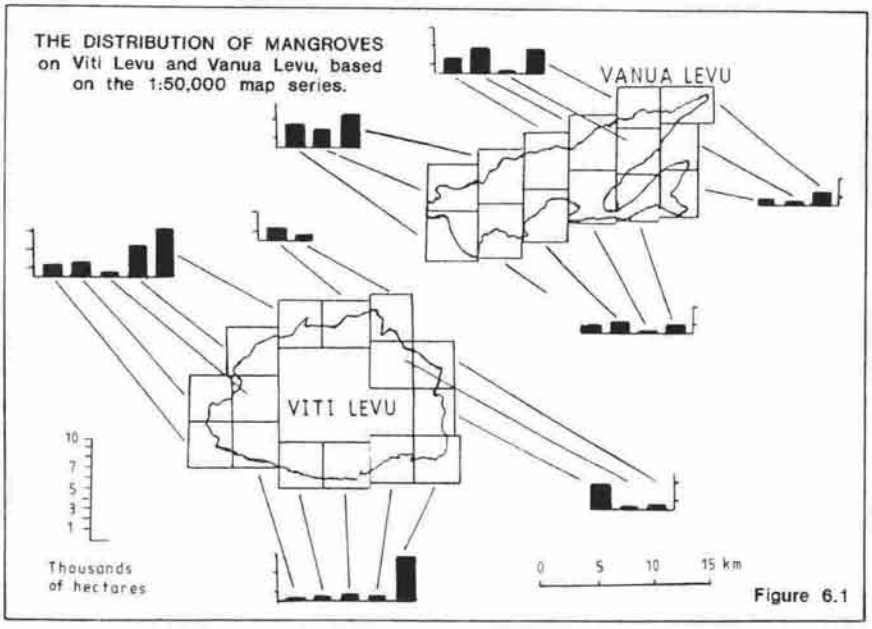


Figure 6.1

6.3 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 Map 6.2.

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, but 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.

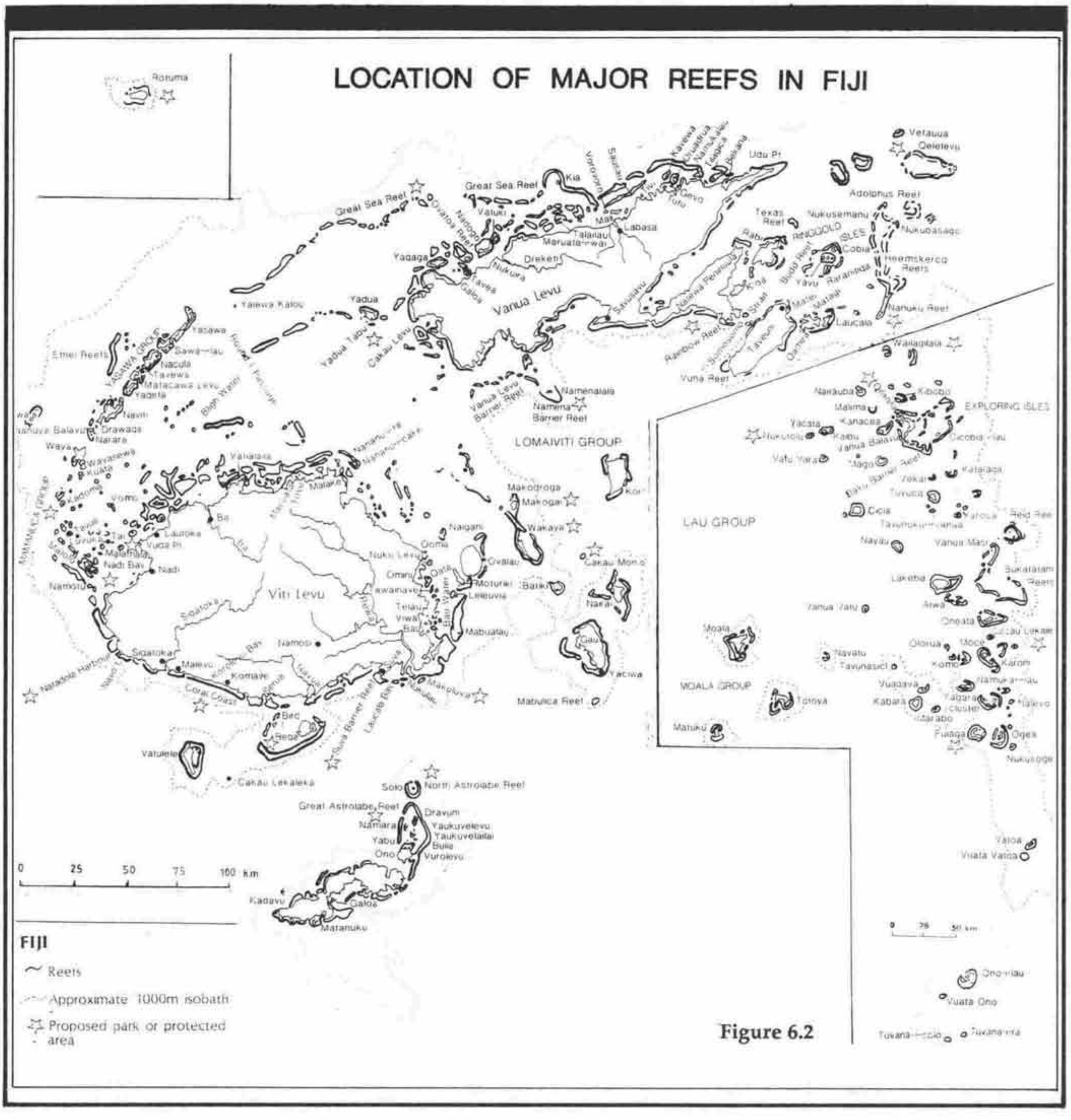


Figure 6.2

6.4 OTHER MARINE HABITATS AND FEATURES

6.4.1 Marine habitats

There has been no inventory of inshore marine habitats with the exception of mangroves (6.2). 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.

6.4.2 Special Environmental features

Anchialine pools (ie those pools separated and at some distance from the sea but still under tidal control) 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.

There has been no inventory of inshore marine habitats with the exception of mangroves...

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 Matuku.

RESOURCE USE - THE DEVELOPMENT PATTERN

7 SOCIAL AND ECONOMIC DEVELOPMENT

7.1 GOVERNMENT'S ECONOMIC POLICIES AND STRATEGIES

7.1.1 Recent changes

The Government established important new economic policies in 1989 which are aimed at improving standards of living in Fiji during the 1990s. During the previous two decades, Fiji's economic and development strategies promoted import substitution and the protection of key industries. The current policies emphasise acceleration of the rate of economic growth, principally through the expansion of exports.

A programme of deregulation has been followed, including the ending of import licensing, the phased reduction of tariffs and reform of the tax system.

The new policies also require restraint on the growth of the public sector to ensure availability of resources for private sector growth. The Government's role in commercial activity is being reduced by corporatisation and commercialisation of public enterprises.

Improvements in public services remain a high government priority, as essential components of the overall standards of living.

7.1.2 Economic prospects

The new policies are expected to accelerate the rate of growth of the Fiji economy in the 1990 s. Manufacturing is likely to be the major sector to benefit from deregulation and tax reform. Government's role is seen as the creation and maintenance of an economic environment conducive to effective private investment in the Fiji economy. The tourism industry is expected to expand rapidly.

7.2 THE URBAN ENVIRONMENT

7.2.1 Population growth

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.

7.2.2 Building and the urban environment

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.

Residential subdivision has in the past frequently been poorly planned and controlled, even by Statutory Authorities. The most notorious being the Davuilevu Subdivision, now a barren, treeless moonscape...

Fiji has, in the past, been badly affected by tropical cyclones which have caused tremendous damage. There is a major dichotomy in the building 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 Standards 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, has in the past frequently been poorly planned and controlled, even by Statutory Authorities. The most notorious being the Davuilevu Subdivision, now a barren, treeless moonscape which was formerly 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 appeal and charm 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 over-development and lack of landscape controls.

7.3 ENVIRONMENTAL HEALTH

One advantage 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.

7.3.1 Primary health care

The current approach to health development is termed Primary Health Care (PHC) which shifts the priorities of the Health Ministry from a perception of health as predominantly disease-oriented and curative, to one that emphasises the prevention of ill-health, the removal of health risks and the promotion of health. Conceived in these terms, the improvement of health requires more than the services delivered by the health sector alone. The contribution of other sectors, in particular agriculture, education, housing, public works and communications, is recognised as vital for improving the health and well-being of the population.

Only sexually transmitted diseases and 'lifestyle' diseases are currently increasing.

Box 7.1 *NINE MAJOR COMPONENTS OF PRIMARY HEALTH CARE ARE DISTINGUISHED:*

Environmental sanitation
Safe water supply
Food and nutrition
Health education
Maternal child health and family planning
Immunisation
Appropriate health care
Prevention & control of communicable disease
Essential drugs

The PHC concerns in Fiji vary between the urban and rural areas. In the rural areas, the main PHC and environmental concerns are gross deficiencies in basic sanitation, whereas the problems confronted today in the main cities and towns are primarily those of pollution and health hazards associated with industrialisation, urban growth and life styles, unbalanced diets, modern transport and poor quality housing.

7.3.2. Disease and malnutrition

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 none of the domestic water supplies and domestic wastes are treated, water-borne diseases such as typhoid, dysentery, leptospirosis, ascariasis, diarrhoea and ancylostomiasis occur sporadically. The spread can be largely attributed to either poor hygiene practices or the use of contaminated water.

There are disturbing trends in the incidence of both malnutrition and degenerative and metabolic disorders such as diabetes, gout and cardiovascular diseases.

Although gross poverty is rare in Fiji, childhood malnutrition is high. Since 1971 there have been an average of 100 per year admitted to CWM Hospital who showed clinical evidence of severe malnutrition almost exclusively of the protein-energy type. It is estimated that this represents only 5% of such cases in the community. Nearly 90% of these were Fijian children. In 1989, 38.5% of the admissions to the CWM children's ward had less than 80% of the recommended weight per age value (malnutrition) and 10% had less than 60% (severe malnutrition).

Prevalent Fijian cultural practices of weaning children on tea and mashed starches and not protein or fat foods and leaving older children the dregs of meals are major factors in malnutrition in Fijian children. A decrease in the practice and duration of breast feeding is also a factor. In the past decade the National Food and Nutrition Committee has worked actively to counteract these practices. For Indians, malnutrition starts in the foetal stage as a large number of pregnant women are anaemic because of a poor diet and consequently children of low weight.

Diet-related diseases have reached epidemic proportions. Diabetes affects about ten per-cent of the population...

Diet-related diseases have reached epidemic proportions. Diabetes affects about 10% of the population, a ten-fold increase in the last 20 years. The incidence of obesity, hypertension, heart disease, gout and some cancers are also high and increasing. The main cause is dietary change from a traditional diet high in energy, fibre and nutrients to refined carbohydrates and processed foods. Cigarette smoking, alcohol consumption and more sedentary habits add to the problem. Malnutrition and these diet-related diseases have large medical costs as well as losses of productivity to the country.

7.3.3 Mosquito control

Dengue fever and filariasis are the two important mosquito borne diseases prevalent in Fiji, 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 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.

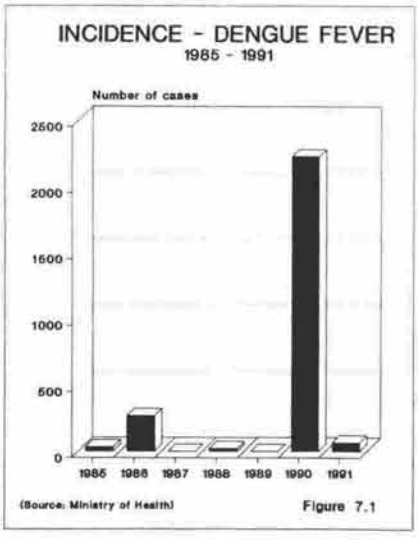


Figure 7.1

The increasing 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. The present Suva rubbish dump has been found to breed vector mosquitoes. Industrial areas can also create ideal situations for mosquito breeding, for example keeping of derelict vehicles.

Dengue fever is spread by the mosquito *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 south east Asian countries (14.3.2).

Dengue is endemic in Fiji and outbreaks of the disease is experienced periodically. Occasionally deaths occur. Figure 7.1 shows the incidence of dengue during the 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 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.). 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. Use of organophosphate insecticides can have high toxicity to fish and invertebrates and this kind of use can destroy many desirable organisms including fish and natural predators of mosquitoes. Simultaneous programmes of larviciding using Temephos are also carried out to control immature stages of mosquitoes.

7.3.4 Water supply

Access to safe, clean freshwater supplies for all is an important national objective to which considerable resources have been allocated. The issue is examined in Chapter 11.

7.3.5 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 Chapter 17.

7.4 VALUES AND ATTITUDES

7.4.1 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.

7.4.2 Environmental awareness

The only formal environmental education programme was that undertaken by the National Trust of Fiji's mobile unit which visited schools between 1982-1988. This has been discontinued. Environmental awareness in all communities in Fiji is generally regarded as being at a very low level, but a recent survey by the NEMP indicates that this may not be the case, instead there is an inability to articulate concerns and an unwillingness and inability to act on them. Recently the Government of Fiji has made a significant effort

The only formal environmental education programme undertaken by the National Trust of Fiji's mobile unit which visited schools between 1982 and 1988 has been discontinued.

to initiate realistic environmental control and management with the establishment of an Environment Unit in the Ministry of Housing and Urban Development, 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.

7.4.3 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 it has yet to become established and active in the field.

The National Trust for Fiji was set up by Ordinance in 1970, and as a statutory body but nonetheless with many of 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. Unfortunately, the Trust has consistently failed to attract significant Government support (see 18.1.4). This, in part, explains its abrogation of responsibility for management of the Garrick Memorial Park, a gift to the nation (see Box 20.2) resulted in the virtual loss of one of the most important conservation areas for tropical rainforest in Fiji.
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 Bouma 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.

7.4.4 Social attitudes

In Fiji's multicultural society with its imbalances 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 initiatives 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 are 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, continue. Wildfire remains a primary 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 environmental 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 AGRICULTURE

8.1 GENERAL AGRICULTURAL PATTERN

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.

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

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 Development Plan 9 but the achievements in both planted area and yields have been poor. About 3970 ha of cocoa had been established by 1990 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, mainly as a stock feed component.

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.

Box 8.1 THE TRUE COST OF THE RAVIRAVI AND DREKETI MANGROVE RECLAMATIONS

In the past, and unfortunately to a small degree today, the widely held view was that mangroves were empty wastelands. We now know that mangroves are very productive ecosystems which sustain coastal fisheries. They have a major economic role in the lives of coastal villagers and fishermen. However, normal financial analyses for development projects usually ignore these benefits because they are difficult to value accurately, while the difficulties of utilising the acidic mangrove soils have consistently been underrated or ignored. This has resulted in mangroves being prime targets for reclamation for sugar cane, rice, aquaculture etc. with quasi-economic justification.

Recently economic analyses which include the benefits mangroves provide to society and including the real development costs associated with overcoming the problem soils, have been undertaken. These analyses show that such large projects as the Raviravi reclamation and the Dreketi Rice Irrigation Project were not financially viable projects in the first place and the removal of mangroves has resulted in a substantial economic loss of over $5 million.

Large scale reclamation of mangroves, popular 'development sites', have proved economically unviable and resulted in considerable national financial losses.

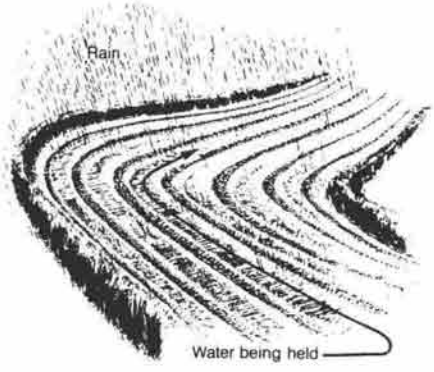
The conclusion is striking, the natural benefits of the mangrove ecosystem are much more valuable than conversion for agricultural development.

Financial losses associated with the conversion of mangroves

Raviravi (350 ha) - 282 ha under sugarcane*; 24 ha aquaculture

	Nett Present Value ($)
Development (Nett benefit)	-3,295,000
Lost mangrove benefits	
Fisheries	957,000
Wood, traditional uses etc.	57,000
	-4,309,000
Dreketi (242 ha) - irrigated rice	
Development (Nett benefit)	- 227,000
Lost mangrove benefits	
Fisheries	662,000
Wood, traditional uses etc.	51,000
	- 940,000

Source derived from Lal (1990) - figures rounded
Note: (* sugarcane never in fact commercially planted)

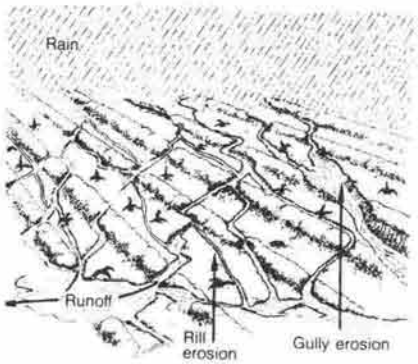


8.2 THE EROSION SITUATION

There are significant areas of man-influenced soil erosion in the main watersheds of Viti Levu and Vanua Levu. In the Ba valley, for instance, an estimated 12,000 ha of sugar cane farm land is in need of urgent soil conservation work, including 6,500 ha that should be put to a less erosive form of land use. In the same valley there is an estimated 35,000 ha of degraded grasslands which would be more stable and productive if afforested. In the central Rewa, over 4,000 ha in the ginger/root crop rotation need urgent soil conversation measures, while similar works are needed in 2,500 ha currently under sugar cane in the upper Wainibuka.

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

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.

Box 8.2 *LAND DEGRADATION IN ACTION - SUGAR CANE ON MARGINAL SOILS*

Soil changes following sugarcane cultivation have been the subject of considerable discussion in Fiji and it was estimated by 1960 that 20,000 ha of land had been 'retired' from agricultural use as a consequence of damage caused by unsustainable cane farming practices.

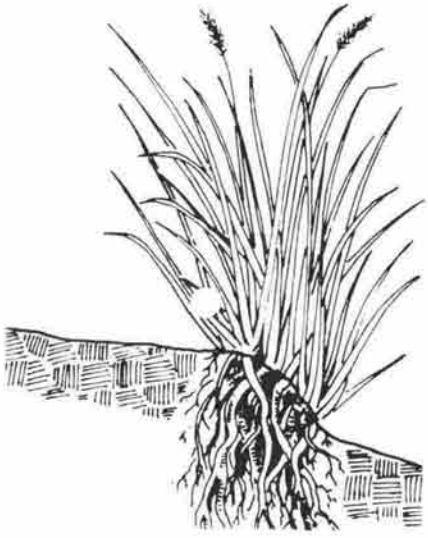
In the early 1970 s the Fiji sugar industry embarked on a major expansion at Seaqaqa, Vanua Levu. Development began in 1974 and by 1984 some 5,500 ha in the Seaqaqa area were under cane producing 264,000 tonnes of sugarcane. Prior to sugarcane cultivation, the Seaqaqa area was dominated by talasiga grasslands and non-commercial forest.

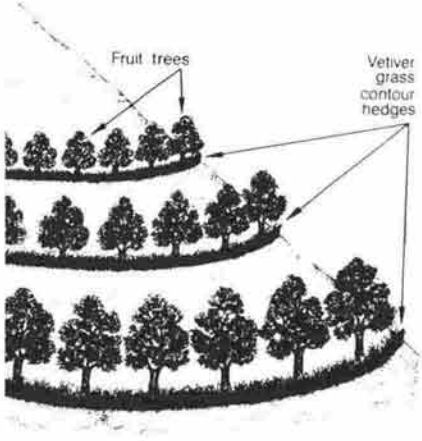
Advantage was taken of the new development at Seaqaqa to study changes in soil properties during the crucial first few years of cane cultivation.

The results were dramatic with marked changes in the topsoil properties including pH, organic carbon, cation exchange capacity, water retention and exchangeable bases. The changes generally related to a decrease in organic matter (through erosion) and to an increase in bulk density due to structure degradation and erosion of organic rich topsoil.

During this period 15-20cm of soil were lost over the entire site. The decline in organic matter and the associated decrease in cation exchange capacity together with the increase in bulk density are all detrimental to sugarcane growth and yields and if not stabilised will lead to unproductive land. Every effort, therefore, needs to be made to ensure that a further decline in soil quality does not occur following the changes that result from the initial land clearance and preparation activities. The data indicated that insufficient amounts of bases (for example calcium, magnesium, potassium) were being added, at least in some years, to compensate for crop removal and leaching losses. This is a critical factor in maintaining the productivity of soils which have low natural levels of bases. Declining yields in some areas can be related to loss of topsoil through erosion and insufficient fertilizer application.

Management systems that facilitate crop residue retention and incorporation (not burning the cane trash) and which minimise erosion (for example - planting on the contour, use of vetiver grass bunds) need to be practised, not merely recommended.





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.

8.2.1 Vetiver grass

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, throughout the older cane growing areas, 20-40 years after they were planted.

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.

8.3 MANAGEMENT AND PLANNING IMPLICATIONS

8.3.1 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 on to slopes over the past twenty five 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 substainable 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
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.

8.3.2 Off-site damage

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 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 hydro-electricity.

...the already high rates of erosion that occur naturally on Fiji's steeper lands are considerably increased by human action.

The ginger industry is clearly based on unsustainable agricultural practices, and these need to be eliminated.

8.3.3 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 cultivation 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.

8.3.4 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 counter-measures. 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.

Although the close relationship between the Fijian people and their land is continually emphasised, it is not manifested in an awareness of the need to husband soil resources and its fertility.

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, it is not manifested in an awareness 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.

9 FORESTRY

9.1 AREA OF THE FOREST RESOURCE

The area of Fiji's indigenous forest and its subsequent management is based on a study undertaken between 1966 and 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 6 different categories were distin – guished.

Table 9.1 Estimate of the forest resource in Fiji

	Hectares	%*
Natural Forest Areas:		
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
Plantation Forests:		
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.

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.

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 afforesta-

tion 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 ha) 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.

9.2 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 ha 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 the National Environment Management Project).

These figures ought not 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 excessive.

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 smallholder 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 premanently reduce forest cover. 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.

9.3 PLANTATION FORESTRY

9.3.1 Afforestation and reforestation programmes

Fiji has embarked on some highly successful plantation establishment programmes. The softwood plantations total over 43,000 ha (Table 9.1) 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.

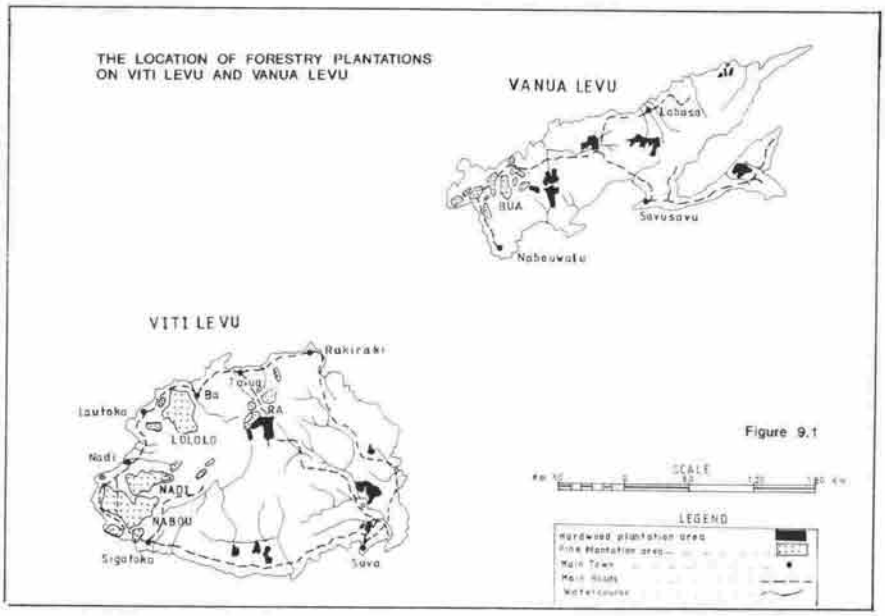


Figure 9.1

9.3.2 Environmental impacts of the plantation programmes

The establishment of the softwood plantations has 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 which is proving remarkably vigorous in some Fijian localities. The possibility that mahogany may invade native forest and disrupt its ecology requires consideration.

- For convenience, establishment of plantations follows logging. If 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 (Table 9.1).

- 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.

There is a severe imbalance in the distribution of forest with the drier parts of the larger islands and many smaller islands have suffered severe deforestation. In such areas, even a moderate loss of forest can be excessive.

The establishment of the softwood plantations has had, in balance, overwhelmingly positive environmental impacts.

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

9.4 DEVELOPMENTS IN THE FORESTRY SECTOR

9.4.1 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 the 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 occuring, the defacto assumption in current forest management of 200,000 hectares as the sustainable area for timber productiion 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, to approach those of sugar and tourism.

9.4.2 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:

- Protection and the prevention of damage to the still existing forest cover.
- 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.

9.4.3 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. Notable 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 by loggers.

While the adoption of a National Code of Logging Practice is welcome, it is clearly only as good as its enforcing officers and the resources made available to them by Government.

9.5 LOGGING AND WILDLIFE

9.5.1 Current practices

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 pressure the authorities to act.

While the adoption of a National Code of Logging Practice is welcome, it is clearly only as good as its enforcing officers and the resources made available to them by Government.

The root causes of environmental damage from logging are:

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

9.5.2 The effects of 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 unstable and erodible geology and topography and highly erosive rainfall patterns. 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. This is, in part, a legacy of their 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 is clearly insufficient attention 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 in Vanua Levu. Its findings were uncertain. However the following are general findings from experienced observers:

- Fiji's fauna is small in number but has a high level of endemicity (more than 30% in all well studied groups with the exception of bats).
- The native fauna of the larger islands is primarily adapted to forest and for example, all endemic species on Viti Levu, for which information is available, inhabit forest; the majority are restricted to forest or forest association.
- Altitudinal and regional differences in faunal distribution within the remaining primary forest on Viti Levu appears to be minimal; Moss Forest is an important exception in the butterflies and moths, at least.
- Restricted ranges of many plant species are well documented, which makes the flora particularly vulnerable to poorly managed logging.
- 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.
- The present management of Protection Forests is inadequate and this has serious implications for the long-term conservation of Fiji's wildlife.

The Fiji Warbler

- Reforestation of logged-out Production Forest with exotic hardwoods will have more serious long term consequences for wildlife than selective logging.

9.6 MANAGEMENT AND PLANNING IMPLICATIONS

9.6.1 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 the 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.

Of perhaps the gravest concern is the inadequate management and control of Protection Forests... which may hold the key to the long term surivival of Fiji's wildlife and to the proper functioning of water catchments.

Deforestation is an immediate issue for the forest industries which need 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 and 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.

9.6.2 Future direction

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

Lack 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 salutory example -revenue and cost considerations will always prevail over environmental and social concerns unless Government retains the initiative and the political will.

Any strategy to control deforestation must include the means to determine the distribution, quantity and ongoing quality of the existing forest resources and monitor their use. Thus the Natural Forest Inventory now being undertaken should not only quantify the existing Forestry resource but put in place an on-going 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 actively direct environmental management within the sector in order to avert international criticism.

10 FISHERIES RESOURCES

10.1 RESOURCES

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

- Offshore resources: pelagic and demersal fisheries 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 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 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 is regional concern 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. 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).

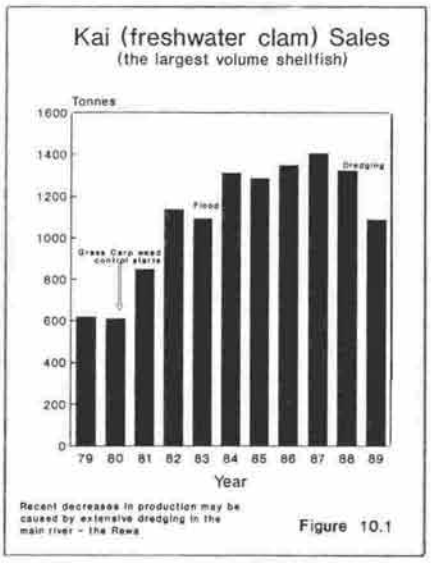


Figure 10.1

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.

10.2 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. Licensed inshore fishermen are not yet obliged to report their catches, and the data tabled in the Appendices come mainly from surveys of commercial markets. 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 10.1), 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, (Table 10.2) 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.

10.2.1 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 is incomplete. 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.

Table 10.1 Value of fish catch, imports & exports F$ thousand

1987	1988	1989	1990 est	
1. Finfish catch for domestic sale	11,464	12,009	14,716	17,219
2. Non-finfish catch for dom.sale	1,754	2,867	2,774	4,096
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	21,063
Fiji commercial catch	29,345	40,703	42,823	54,878
5. Whole Fish imports, (incl tuna for canning)	8,165	9,817	11,178	5,306
6. Canned Fish import	3,650	3,674	4,144	3,195
Total Imports	11,815	13,491	15,322	8,496
Total commercial fish supply	41,160	54,194	58,145	63,374
7. Estimated value of subsistence catch	30,000	34,000	43,000	48,000
Total fish supply	71,000	88,000	101,000	111,374
8. Canned tuna export	20,800	39,700	39,400	41,721
9. Other exports	8,500	9,200	10,600	21,063
Total Exports	29,300	48,900	50,000	62,784

Source: Fisheries Division, MPI.

Table 10.2 Tonnages of non-finfish sold through domestic outlets

	1986	1987	1988	1989
Crustaceans	259	239	242	249
Bivalves[1]	1,476	1,509	1,484	1,195
Gastropods	15	25	46	54
Echinoderms	30	116[2]	321[2]	70
Seaweed	9	11	12	11
Turtle	5	14	4	5
Miscellaneous[3]	9	12	11	17
TOTAL	1,803	1,926	2,120	1,601

Source: Fisheries Division, MPI

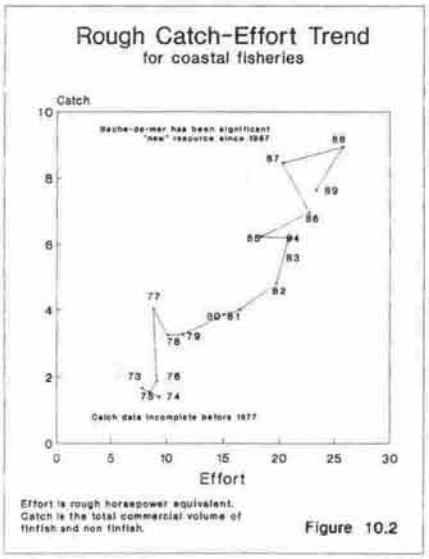
Note: 1. Normally with shell included in weight & mainly composed of freshwater 'kai'.

2. Mainly beche-de-mer destined for eventual export.

3. Includes seahare, chiton, cephalopod etc.

With reference only to the commercial reef and lagoon fin-fish fishery, a simplistic analysis of trends over the past 15 years suggests increased effort (in terms of vessel registrations and horsepower) is followed by increased catches (Figure 10.2). There is certainly no marked tailing off of catch following increased effort that characterises overfishing in coastal areas such as the Philippines.

The available data 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 the rapid economic changes since 1987 will be a major factor in limiting the expansion of the 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.



Effort is rough horsepower equivalent. Catch is the total commercial volume of finfish and non finfish.

Figure 10.2

10.2.2 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 distinguish 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 becoming involved in their own marketing.

10.3 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 are 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.

10.4 AQUACULTURE

Aquaculture methods, both freshwater and marine, have been subject to investigation and development by the Fisheries Division 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.

Box 10.1 *AQUACULTURAL INITIATIVES:*

- Oyster. Shelved in 1981 as being a poor development option for Fiji. Productivity did not appear to be enough to support investment.
- Green mussel. Shelved in 1987 for the same reason.
- Molly culture, to supply baitfish for pole and line tuna fishing. Aborted in 1982 following the assessment of large natural supplies of bait.
- Macrobrachium prawn culture. Development still ongoing. A hatchery system is in production but growout methods are being optimised.
- Penaeid shrimp culture. Government trials on the use of reclaimed mangrove land for aquaculture were privatised in the early 1980's to a joint Fiji/France venture. Production never came up to expectation, but new investment hopes to make the farm a success. Another, but smaller scale, foreign-owned shrimp growout farm has started recently at another (better) site.
- Grass carp culture. As a public service to control water weed overgrowth due to increasing riverine eutrophication, this programme has been successful in that aim, and grass carp are also caught for food by inland villagers. Trials on polyculture of grass carp with other species are underway.

- Giant clam. The hatchery established on Makogai island in 1988 is now producing around 100,000 viable seed-clams per year, and rural growout trials will be started in 1991. This project is aimed more at resource maintenance than at export marketing, but there appears to be commercial potential.

- Tilapia culture. After 8 years of development effort by the Fisheries Division, aimed at inland subsistence farmers, larger commercial farms are being started. Contrary to initial expectations, Tilapia are proving to be a popular market fish, and production is set to expand rapidly in the near future from its estimated level of 20 tonnes in 1990.

- Seaweed farming. The seaweed culture industry has had a chequered history since its inception in 1984. Due to various local and global economic factors, production has never become large enough to justify an in-country carageenan processing plant, but the cultivation of this seaweed has considerable potential. 99 small-scale (family) farms are currently in production, and the product is entirely exported.

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 industries, these constraints may possibly be overcome in the short to medium term and an industry established.

In the meantime, the main thrust of Government aquacultural development in Fiji is on extensive (low capital, low technology) methods either for low value, high demand export markets (seaweed), local higher-value markets (shrimp, prawn and tilapia), subsistence (tilapia) or 'environmental management' (grass carp, giant clam).

In view of the continued recent shortfall of fish to local markets, the Fisheries Division is stimulating interest in aquaculture as a way of supplying the long-term needs of a growing human population in the face of a finite wild fish population, but it is too early to say whether large-scale aquaculture will succeed, or even whether it is desirable. Within the next decade attention needs to be focused on the legislative and environmental impact aspects of aquaculture to mitigate the kind of problems that have arisen from intensive fish-farming in more developed countries, in particular relating to water usage, polluted return water and appropriate land use.

Within the next decade, attention needs to be focused on the legislative and environmental impact aspects of aquaculture to mitigate the kind of problems that have arisen from intensive fish-farming in more developed countries.

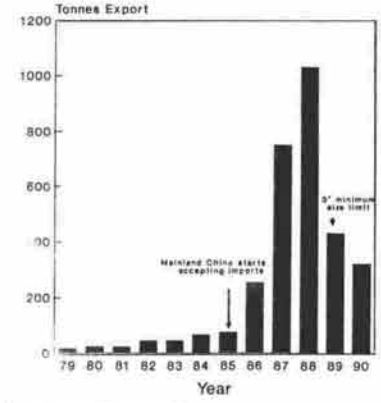
10.5 LONG-TERM SUSTAINABILITY OF FIJI'S FISHERIES

The only significant long-term fisheries development prospects for Fiji (in terms of volume) are likely to be in the offshore (particularly pelagic) fisheries. Unfortunately, such fisheries are highly capital-intensive and, unlike most Polynesian countries, participation in such fisheries is not part of the traditional way of life in Fiji. Most of the future development effort of the Fisheries Division will encourage Fiji fishermen to move offshore, through the deployment of offshore fish-aggregation devices, the promotion of value-added methods and the development of attractive markets.

Whilst coastal fin-fish fisheries still appear to be in good shape, there is a growing feeling that management measures must be improved if these fisheries are to be maintained into the future. Although outer-island fin-fish fisheries are generally under-exploited due to marketing problems, they have limited development potential. The assessment of available resources on a finer scale, and the strengthening of management measures by the owners of customary fishing rights, will be part of future Government strategy.

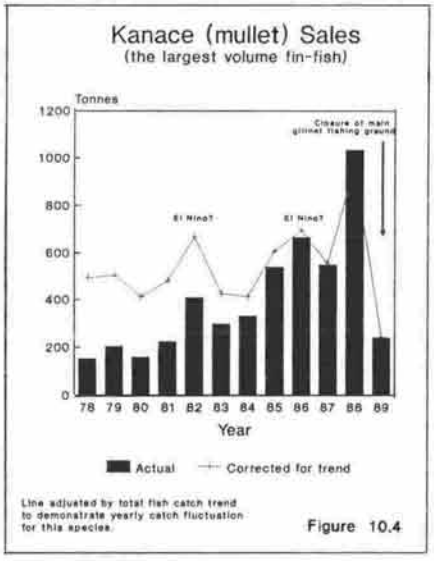
The coastal non fin-fish fisheries ('sedentary' resources such as molluscs and crustaceans) are often vulnerable, and several individual resources are already overfished. These have been the focus of most recent control measures, particularly at the point of export. The paradox for Government is that the products of these fisheries are usually non-perishable (eg. turtle shell, trochus shell, dried beche-de-mer, pearl shell), and high-value, and thus very suitable for outer-islands and rural areas where the transport of fresh fish to market is difficult, and where such fishing is often a major source of income. Many customary fishing rights owners recognise that a medium-scale effort will be of greater long-term benefit than large, short-term financial returns, and have taken voluntary control measures. But this effort is continually undermined by approaches from exporters and the threat of poaching.

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 10.3



Line adjusted by total fish catch trend to demonstrate yearly catch fluctuation for this species.

Figure 10.4

The solution to the inshore sedentary resource problem is to reduce fishing effort, and to introduce management measures such as rotating harvesting areas, and the setting aside of breeding reserves, together with better marketing to maximise the value of the existing resource. In the longer term, the Fisheries Division is developing techniques for outer island and rural mariculture. Extension trials using cultured giant clams are already underway, and the hatchery on Makogai is also looking at trochus and pearl shell culture. It is not envisaged that large scale reef-restocking will ever compensate for overfishing, but marine farming could become an alternative source of income for outer island fishermen and reduce pressure on natural stocks. Pearl culture has become very successful in certain parts of Polynesia, and may be another option for the future. Seaweed farming will also be a 'diversion' if that industry overcomes its current teething troubles.

Traditional fishing rights 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. Increasingly, members of the ownership of a qoliqoli are becoming involved in business and, in certain cases, consider that the qoliqoli is simply a source of disposable income to be tapped for immediate gain, or to attract joint-venture partners.

To enable village-level fisheries management, more information on the state of the resources in the areas under their control must be made available to qoliqoli owners. There already exists quite substantial legal powers of resource management, and these need to be made effective through regular advice. For example, certain misconceptions need to be laid at rest, such as the increasingly-held view that tuna-boat baitfishing is severely reducing coastal food-fish catches, or that the use of naturally-occurring fish stupefacients is acceptable because it is a traditional fishing method.

Unlike 'western' countries, where marine spaces have traditionally been held in common, marine spaces in most Pacific islands are traditionally subdivided amongst specific ownership groups. The main problem with the western concept is that fishermen over-exploiting a common resource do not have the restraint of long-term self interest. The main problem with the Pacific concept is that it is (like most land-owning systems) potentially socially divisive. The problem is particularly acute in Fiji, where 50% of the 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 dis-enfranchised.

MAN AND THE ENVIRONMENT

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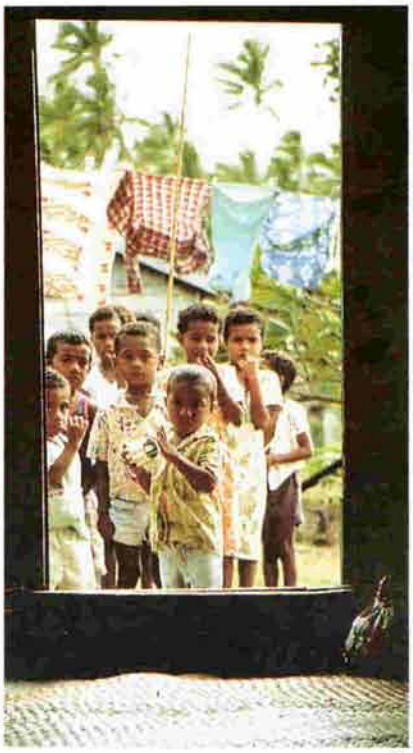

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Fiji's natural environment has been subject to change ever since the arrival of the first settlers. Forest covering all the islands has been much reduced, today's high quality landscapes (2) used to be forest clad. Traditional Fijian communities (1) were more directly reliant on the environment for food and shelter, their ability to irreversibly alter it was limited, but today with the assistance of modern technology we can rapidly make major changes (4). Our use of natural resources has often been unsustainable and we often appear to forget that we hold the environment and its resources in trust for future generations (3).

THE COASTAL

The coastal zone is of vital importance to Fiji. It brings together an unique assemblage of resources such as reefs (6), mangroves (2), wildlife habitats (7), agriculture, sea food, beaches (5) and quality landscapes. Yet the zone is shared with every significant town in Fiji, the majority of villages and the vast majority of the population together with industry and commerce. Recurring issues include the loss of mangroves through reclamation : Denarau (1) and Raviravi (3); siltation and other short term impacts from construction activity (8); inadequate appreciation of coastal processes and climatic factors in siting developments — Sheraton Hotel (4); and the need for sustainable management of marine resources (9).

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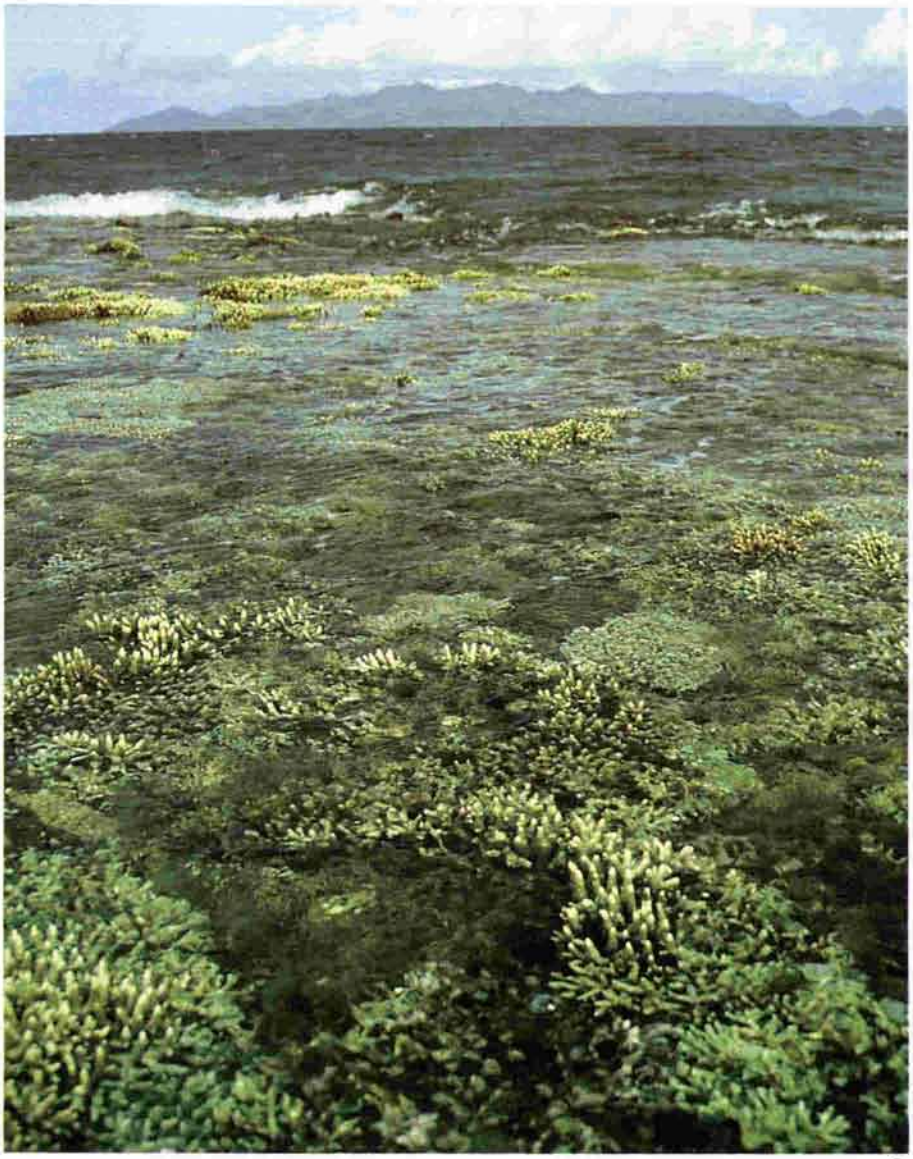

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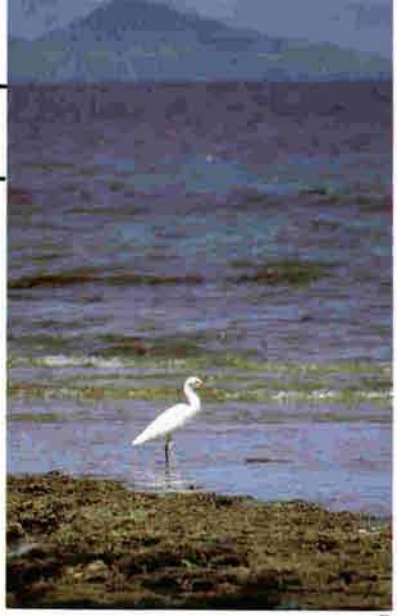

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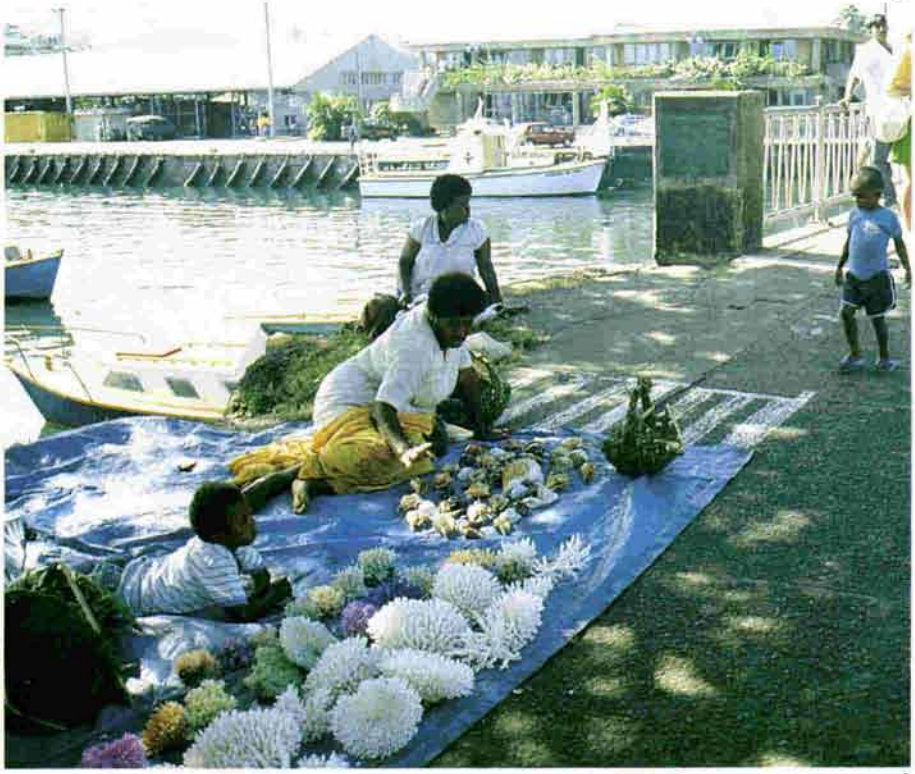

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LAND USE A D

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Fiji's future land based development faces considerable problems. First class arable land (1) is almost fully utilised, the remainder will require significant land conservation management which is currently lacking. The recent development of the ginger industry (3), expansion of sugar cane production (2) and intensive goat farming (8) have been largely in marginal steeplands with inadequate soil conservation measures and are clearly unsustainable. The role of natural forests (6) in sustaining Fiji's rivers and

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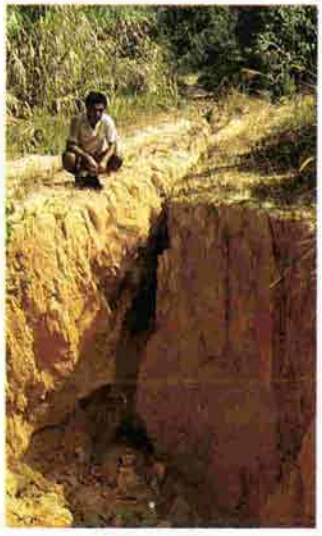

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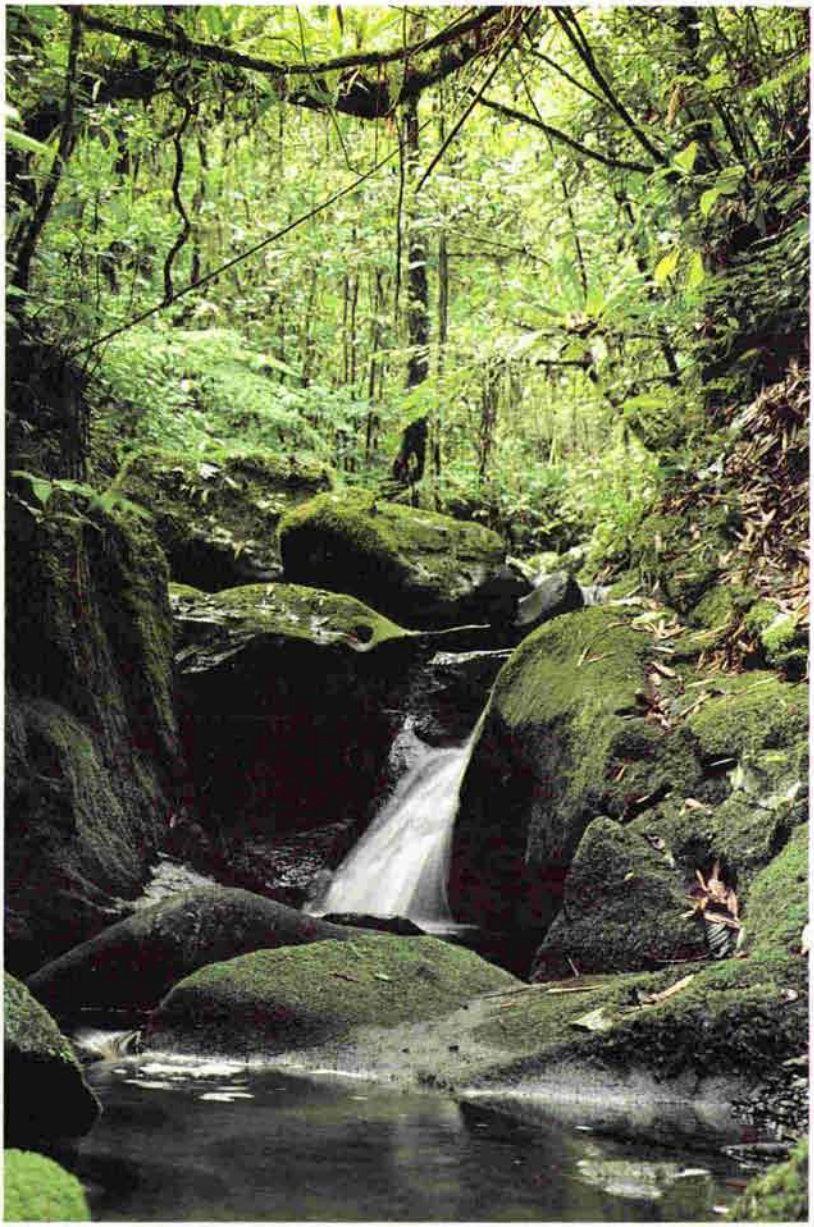

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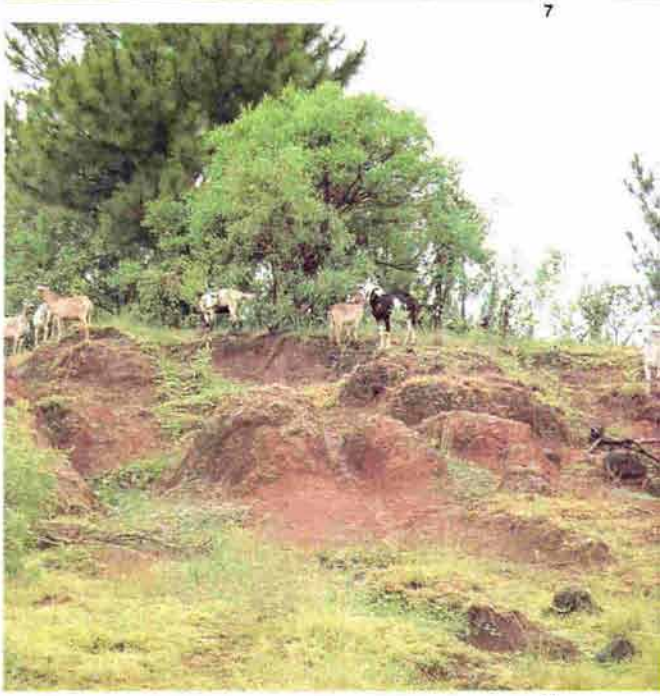

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freshwater resources has long been ignored. It can only be replaced by active management of water catchments based on sustainable land use. Plantation forestry (9) has been very successful but the logging of the natural forest has been poorly controlled (5) which can lead to irreversible changes in forest cover, serious erosion (4) and siltation of water supplies (7) - Ba Reservoir.

HUMAN SETTLEMENT

Adequate housing is a basic necessity of life (7), yet there are many people in Fiji living in intolerable conditions, this is especially so in peri-urban areas where squatter settlements are an increasingly common feature (1). For some there is no alternative but to scavenge at poorly managed rubbish tips (3), while many others are exposed to a wide variety of pollution (2).

Developments are not always beneficial, changing landuse in watercatchments can cause river erosion many miles away affecting innocent communities (4).

Poorly developed housing schemes, as at Davuilevu, attempt to entice house buyers to live in pocket deserts where previously luxuriant forest grew (5) and (6).

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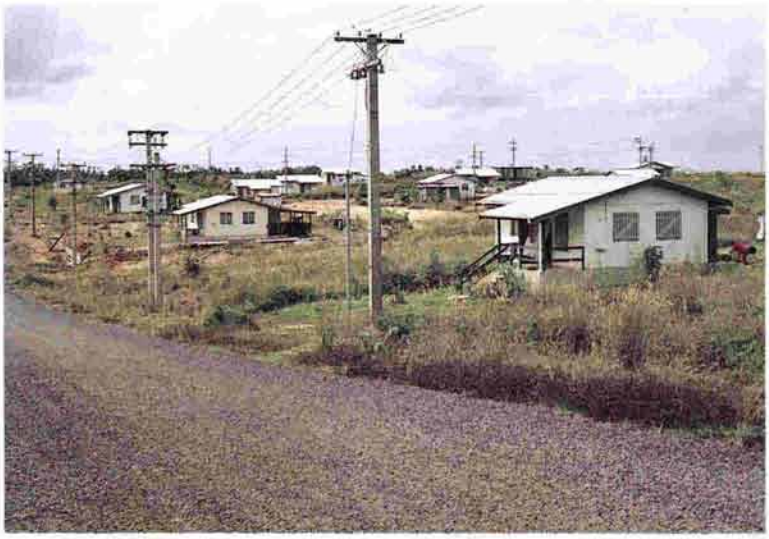

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THE NATURAL

Fiji's natural heritage is frequently undervalued or ignored in favour of novelty or the exotic, yet tourists come many thousands of miles and at great expense to savour Fiji's natural heritage. Fiji is fortunate to retain nearly 50% forest cover (1), while Fiji's reef resources are enormous (2). There are many unique landscapes (3) but few are protected or have public access. Ancient sites (4), (7) need increasing protection, and tourism could play a role here, as at the Tavuni Hill Fort (7). Birds are the most conspicuous form of wildlife, some species such as the Crimson-crowned Fruit Dove are plentiful (5), while others such as the Peregrine Falcon (6) are scarce — perhaps only 100 pairs survive. It needs active protection, but more critical is our internationally renowned Crested Iguana (8) which has no legal protection.

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PHOTO: PADDY RYAN

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PHOTOS: PADDY RYAN

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INDUSTRY

The Vatukoula Gold Mine (1) is Fiji's sole operating mine but other prospects may be developed pending current feasibility studies. Thanks to the Monasavu Hydro Dam (2), Fiji is 97% self-sufficient in electricity production but pollution from Fiji's increasing industrial operations remains inadequately controlled (4, 5). However, the Ports Authority of Fiji has recently introduced emission standards for effluents into their harbours, but the existing high levels of heavy metals and Tributyl Tin from boat yards (3) will remain in sediments for many years to come.

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11 FRESHWATER SUPPLY

11.1 SOURCE OF FRESHWATER SUPPLIES

The sources used for water supply in the public, private and agricultural sectors are varied and depend on such factors as the amount and distribution of rainfall, topography and population to be served. On the wetter sides of the two 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.

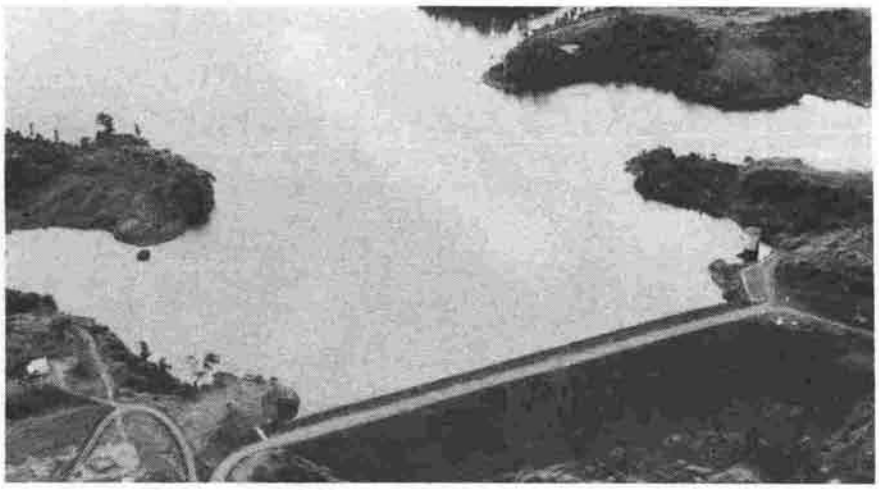
Increasing urban populations and reticulation extensions are creating demands for additional water in many of the urban areas and supplementary supplies to existing schemes are now required to meet the new demand, for example Labasa, Navua and Ba.

On the drier side of Viti Levu, where river or stream flow is periodically insufficient the Vaturu Dam was constructed in the 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 are not close to 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 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 inadequate even when strict water rationing

In most areas water is not reqarded by the public as a scarce resource and waste is commonplace.



Vaturu dam.

is imposed. Requests are then made for government barges to ship water from the main islands to replenish the village tanks. This is obviously expensive since a charge is rarely 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 villages and settlements whose normal water supply suffers from droughts.

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 (see Box 11.1). Community awareness and discipline in such situations needs to be upgraded.

11.2 WATER SUPPLY

11.2.1 Urban water supply systems

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

Water quality 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 in 1991 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 responsibility of the Ministry of Health. 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 applied in the absence of national drinking water standards. Similarly there are no standards for recreational and other classes of water.

11.2.2 Peri-urban water supply systems

The MIPU is also the supplier of piped water systems in peri-urban areas. They manage and determine the charge 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.

11.2.3 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 maintence.
- Lack of technical expertise at the village or rural area level.

11.2.4 Water supply system inventory

There is no accurate inventory for the different types of water supply systems in Fiji.

11.3 UTILIZATION 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 proportion of the island tourist resorts in the Yasawas and Mananucas use some groundwater from shallow bores or hand-dug wells. A number of these supplies are often affected by saline intrusion and so 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 for 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.

11.4 POLLUTION

Pollution of surface and groundwater 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 overpumping of boreholes and wells in coastal areas and on small islands.

Saline water intrusion remains one of the major threats to resource management.

11.5 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.

Water supplies, on small 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 at 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.

Box 11.1 *MALOLO ISLAND - WATER SHORTAGE, REAL OR INDUCED?*

Malolo Levu island in the Mamanuca Group off western Viti Levu is frequently short of freshwater and relies on Government to supply its two villages with barged water supplies. This is very costly.

By comparison with the majority of Fiji's island communities the villages of Malolo enjoy considerable opportunities for employment and rental receipts. There are two tourist resorts paying rent to the islanders and another two very large resorts are on a close neighbouring island, with additional employment opportunities.

In 1989 a mission from the United Nation's Water Resources Assessment and Planning Project visited the island, at the Government's request, to evaluate the water shortage situation. The mission found much of the existing water system was in a very bad state of disrepair, with leaking tanks, fractured pipes, leaking taps and valves, broken gutters and downpipes.

The main village water supply is from Kawabu, a natural water course in one of the inland catchments, which gravity-feeds to a large ferro-cement tank. This supply had not been maintained over the years and the pipes were corroded, the stream had changed its course and the tank leaked, the latter because four of the metal tie-rods had been removed and were probably being used as boat anchors. Very poor flow rates resulted.

Average annual rainfall on the island is approximately 1400mm, which (if each household in the village was to upgrade rain collection), is sufficient for 56% of the community's annual needs. If properly maintained the Kawabu source could supply the remaining water needs of the community.

It is clear from this example that community discipline and direction in water conservation and utilisation would be very important in reducing or eliminating the expensive demands made to the Government for barging relief supplies.

12 TOURISM

12.1 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, 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.

12.1.1 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, 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.

12.2 NATIONAL POLICY

Since 1973, when a comprehensive plan was commissioned, the concept of tourist development regions or the 'honeypot' principle has guided Government, specifically NLTB policy, in tourism development.

The rationale for the concept was based on the fundamental principles of more efficient use of infrastructure and containment of accommodation within specific areas to lessen the extent of any adverse impacts on the natural environment and cultural patterns. These principles were supported by the following locational criteria in the selection of suitable development regions:

- desirable climate;
- attractive environment;
- existing or potential visitor attractions;
- sufficient land for development;
- existing or potential accessibility;
- availability or possibility of development of other infrastructure, especially water supply, at an economically feasible cost.

The implementation of the tourist development region concept occurred through the designation of visitor accommodation regions of either Type A (greater than 1,000 accommodation units) or Type B (less than 1,000 units), and designation of visitor interest areas. Although the rationale for the concept could be regarded as valid (in that it was largely based on genuine concern for Fijian culture and environment), it has been shown to be inappropriate and in need of revision. Nevertheless, the 1973 plan is remarkable in its perceptions of the interactions between tourism development, environment and culture. Some of the more notable issues raised in the plan in this regard are:

- conservation of the natural environment is integrally associated with cultural conservation;
- Fiji's environment is suitable for tourism but is also vulnerable to ecological disruption if tourism facilities are not carefully located and designed,consequently the ecological implications of development are a significant factor in examination of the environment;
- reefs are important for food gathering, tourism, protecting beach and water sport areas and harbours, but are highly susceptible to damage from pollution, coral and shell collecting;
- local residents require high quality beaches for recreation;
- hotels/resorts should be set back 100 feet (30 metres) from the high water mark and public access provided to beaches adjacent to tourism development so that they are available to the general public (this recommendation was subsequently incorporated into the General Provisions (1980) of the Town Planning Act);
- tourism development is dependent on major environmental considerations: amount and location of developable land, distribution of microclimates,and location and extent of beaches, reefs and other natural resources;
- traditional lifestyles are of great interest to visitors but are vulnerable to degradation if change, resulting from tourism and other activities, is too rapid or detrimental;
- land tenure is an important consideration in location of tourism facilities;
- tourism can be used as a mechanism to establish national parks and nature reserves (terrestrial and marine), scenic areas and other points of natural interest.

More recently there has been a second comprehensive assessment of Fiji's tourism sector in the form of the 'Government of Fiji: Tourism Masterplan' published in 1989. With regard to environmental management, the Masterplan notes the strong linkage between the environment and tourism and proposes that one of the national goals for the tourism sector should be `appropriate environmental management'. It recommends that a comprehensive system of parks and reserves should be established, existing environmental impact assessment procedures be endorsed and expanded, and that the Ministry of Health's research and monitoring capability be upgraded to deal with pollution of coastal waters. The Masterplan retains the basic concept of Type A and B Visitor Accommodation Regions but recommends broadening of the Type B category to cover other areas, subject to community attitude and the need for environmental protection. It is in the Type B regions that the concept of `Secondary Tourism Activities' (STAs)

would be best developed. This concept refers to tourist activities/features which are geographically and, usually, economically separate from those available at intensively developed resort areas. It usually refers to activities related to natural environmental features and indigenous culture. The Masterplan estimates that STA development could generate additional tourist expenditure of $30 million in the early 1990s if opportunities are properly developed. Furthermore, due to the geographically dispersed nature of these STAs those that are community and environment based provide an opportunity for local involvement by traditional landowners through management participation and direct financial returns.

Box 12.1 - TOURISM AND THE ENVIRONMENT

"... the quality of the visitors' experience is, at least partly, reliant on the environmental characteristics of the area visited. Tourism must, therefore, be concerned with conservation and enhancement of natural resources to ensure long term viability from both the hosts' and guests' perspective. In other words, **environmental responsibility is good business practice.** Accordingly, the objective for Fiji's natural tourist assets - especially the physical environment and heritage features - is that they need to be managed to ensure that their appeal is not degraded by over-development or over-use."

(Fiji: Tourism Masterplan Vol.1:50)

Box 12.2 - TOURISM AND ENVIRONMENT CONFLICTS - A CASE STUDY

Severe upland erosion resulting from poor logging practices in the catchment behind a major resort on the Coral Coast of Viti Levu has led to siltation of the resort's water supply, resulting in delivery of substandard water to guests and installation of rainwater tanks. The erosion which has resulted in the sedimentation of water courses in the catchment has also diminished secondary tourism opportunities available to the resort (as well as other resorts in the area) in the form of bushwalking activities and freshwater swimming in a rainforest setting.

At the same time, the resort created its own environmental problems by altering coastal processes during initial construction in the mid-1970s, building an artificial island and sea walls. The original engineering works were not properly constructed and are now disintegrating, resulting in coarse stone material from the sea walls degrading the quality of the resort's beaches. The problems associated with coastal processes are compounded by the shallowing of the nearby stream mouth and the lagoon due to the deposition of upstream sediment.

This example illustrates a situation where a combination of factors ranging from lack of resource management in the steep hinterland, absence of cross-sectoral planning and coordination, and lack of imposition of appropriate EIA procedures on the part of Government to poor coastal engineering and locational analyses by the developers now threatens the viability of a resort whose establishment has, to date, fulfilled government tourism objectives and contributed to the economic and social well-being of the traditional landowners. It highlights the need for an integrated approach to environmental management and tourism developments at both national planning levels and during 'on-site' development planning and construction.

12.3 ENVIRONMENTAL MANAGEMENT ISSUES RELATED TO COASTAL TOURISM

There is a range of specific environmental management issues associated with tourism development in Fiji, and it is important to recognise that most are interconnected and that many 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 built too close to the shoreline and/or in low-lying areas and are subjected to damaging storm surge, especially during cyclones 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)

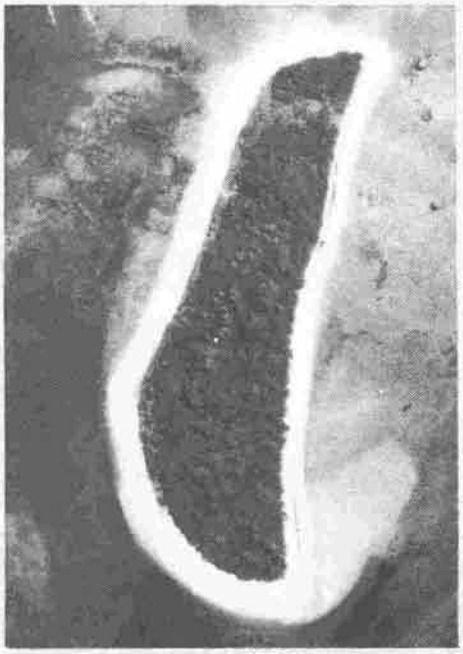
Related to coastal process issues is the predicted sea level rise associated with global warming. Current studies already indicate a relative sea level

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 has applied for a dredging licence to remove sediment under 140 hectares of mangroves to raise the level of the development area, thereby creating another set of environmental problems.

Box 12.3 *MAKALUVA ISLAND - HERE TODAY, GONE NEXT YEAR!*

Fiji's tourism industry is based on sunshine, sand and sea and nothing typifes the south sea island dream more than a resort on a small island. But the current rush to build resorts on every small island needs to be very carefully considered. The recent history of Makaluva is testimony to this. In the 1940s a government quarantine facility was built on the island - today all those facilities are underwater, or 100m offshore. The island has moved!

Every major resort in Fiji has 'coastal process' problems, some of them such as those at Denarau are very severe. Resort developers should realise that tropical coastlines which are subject to trade winds and cyclones are dynamic and they need to plan for this.



1989

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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 environ-

ment 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 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. The statutory requirement for a 30 metres shoreline setback for development attempts to overcome this problem by guaranteeing public right of way. But the reality is that this provision does not address the problem. Socio/ 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.

12.4 THE LINK BETWEEN TOURISM AND PROTECTED NATURAL AREAS

Two seemingly divergent global trends are becoming increasingly interlinked. One is the growing demand for 'specialised' tourism, and in particular tourism in 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 landuse. For this reason tourism has an 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.

12.4.1 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

Of these only Bouma is operational at the present time. They are discussed more fully in Chapter 21.

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

12.5 MANAGEMENT AND PLANNING IMPLICATIONS

It is clear Fiji is currently at a crossroad 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, twenty 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. Concommitantly, 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.

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.

Tavuni Hill Fort.

13 MINING

13.1 CURRENT MINING OPERATIONS

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.

Another form of mining - the extraction of underwater sand deposits, has been undertaken for many years by Fiji Industries Ltd in Laucala Bay, to be used in the industrial manufacture of cement at their Lami site.

13.2 THE EMPEROR GOLD MINE

13.2.1 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.

13.2.2 Environmental considerations

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

- gaseous discharge from the smokestack which if improperly controlled could liberate significant quantities of sulphur dioxide and arsenic;
- 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 at the Emperior Mine was prepared by an ESCAP consultant in 1981.

13.2.3 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 are held on file by the Department.

13.3 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.

13.3.1 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 annual production is approximately 80,000 tonnes of cement, and the operation has run at a loss for several years (although previously it was very profitable).

13.3.2 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;
- 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.

13.4 MANAGEMENT AND PLANNING IMPLICATIONS

The mining sector is exclusively 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 considerations 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.

There is a danger that environmental and social considerations may be considered negotiable in efforts to encourage mining investment.

14 INTRODUCED PLANTS AND ANIMALS

14.1 THE SIGNIFICANCE OF STRICT QUARANTINE

Whenever new organisms are introduced to an alien environment, whether accidentally or intentionally, they usually arrive without their natural enemies or competitors that normally keep them in check.

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. Successful introductions of new organisms into such systems rarely 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 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.

14.2 PESTS OF QUARANTINE SIGNIFICANCE TO FIJI

Fiji is fortunate to be free of many of the world's worst animal diseases.

14.2.1 Agricultural pests

The list of plant diseases not present in Fiji but which could become established if introduced, is very long, Table 14.1 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 the establishment of any one of these would have serious implications for the local meat industry and potential future exports.

14.2.2 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 neighouring Vanuatu and the Solomon Islands. 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 (14.3.3).

Table 14.1 Some pests of major quarantine concern in Fiji

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

Source: NEMP consultants

...the free-ranging goat is a scourge of delicate island vegetation and their soil resources.

14.2.3 Ecological threats

Fiji has been fortunate that with the notable exception of the mongoose (and perhaps the cane toad), 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 Kula 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.

Often overlooked as an ecological threat is the free-ranging goat which is a scourge of delicate island vegetation and their soil resources.

Introduced Toad.

14.3 EXAMPLES OF BREACHES OF QUARANTINE

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

14.3.1 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.

14.3.2 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.

14.3.3 *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.

14.3.4 Pine engraver beetle

In 1982 the pine engraver bettle 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 has become established. Its appearance in Fiji, so far from its native distribution, is both surprising and mysterious. To date it has not proved a pest to pine but this cannot be taken for granted. There are many instances of plant and animal pests which have had insignificant impact for many years before suddenly undergoing a population explosion.

14.4 MANAGEMENT IMPLICATIONS

The absence of many pests and diseases in Fiji provides the nation not only with a healthier environment than many other countries, but also with many economic advantages. These include the absence of costly control measures and an enchanced ability to grow crops and livestock. A vivid example of this are Fiji's valuable hardwood plantations of mahogany. Such planta-

tions cannot be grown in the countries where mahogany is native because of the presence of the tip-shoot borer (see Box 14.1).

Box 14.1 *THE MAHOGANY TIP-SHOOT BORER*

Fiji's pine plantations are conspicuous and the programme is well known both at home and abroad. The mahogany plantations (some 42,000 ha at present) are less well known here in Fiji because they are relatively inconspicuous, but the programme is also very successful and hailed as a notable achievement by many foresters around the world. The plantations increase in value for the nation by over a million dollars each month. In Central and South America, where mahogany comes from, plantations cannot be grown because of a serious pest, the tip-shoot borer. If this was to become established in Fiji then all the plantations could be effectively ruined within a matter of months.

The unwise will say "Well that's very unlikely to happen", but they should then ask themselves how did the pine-engraver beetle get to Fiji from Europe or South Africa (14.3.4) and how did the psyllid hopper arrive in Fiji and other South Pacific countries from Central America in the mid 1980s.

Only strictly enforced quarantine laws reduce the chances.

15 ENERGY

15.1 INTRODUCTION

The interface between energy and 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, while 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 latter 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 minimal.

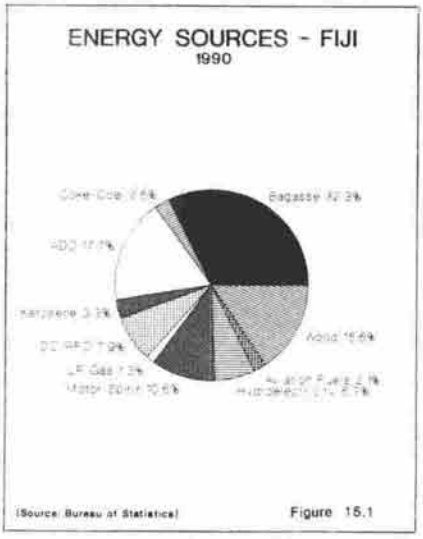


Figure 15.1

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 15.1 gives the energy supply figures for Fiji in both quantities and direct energy unit (joules) equivalents. Here it must be noted that the conversion rates used for the biomass resources are for the "most likely" moisture contents; that is bagasse at about 48% (wet basis) and wood at around 30% (wet basis). The extra column for 1990 gives additional information of domestic kerosene consumption gained from the oil companies. Figure 15.1 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.

15.2 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 bunker 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 15.1 shows the breakdown, according to product type, of the retained imports in terms of volume (or weight) for the years 1983 to 1990. Table 15.2 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 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.

Table 15.1

Energy sources in Fiji - by weight and volume

ENERGY SOURCES FIJI									
YEAR	1983	1984	1985	1986	1987	1988	1989	1990	1990
(a) Retained imports of petroleum (Liters x 10^n)									
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^n)									
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
Source Electrical Energy (Wh x 10^n)									
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	28.9	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 15.2

Energy sources in Fiji by energy equivalent

ENERGY SOURCES FIJI (JOULES X 10^{15})										
	Conv.f	1983	1984	1985	1986	1987	1988	1989	1990	1990
Avtur/JetA1	36.5	0.24	0.40	0.75	0.16	-0.22	0.13	-0.46	-1.14	0.35
Avgas	33.8	0.03	0.04	0.04	0.09	0.04	0.05	0.03	0.12	0.12
MS	34.5	1.74	1.90	2.09	1.81	1.87	1.43	2.01	2.36	2.36
ADO	38.6	3.48	3.42	3.40	3.41	2.74	3.16	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	36.5	0.68	0.39	0.42	0.59	0.76	0.98	1.41	2.22	0.73
R.O	37.0	0.19	0.14	0.27	0.16	-0.01	0.19	0.25	0.14	0.14
Subtotal		9.03	7.10	8.09	7.39	6.19	7.27	7.93	9.25	9.25
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	0.16	0.42	0.56	0.56
Bagasse	8.0	4.24	7.20	6.76	7.98	6.10	6.18	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	3600	0.14	1.03	1.09	1.20	1.19	1.22	1.23	1.60	1.60
TOTAL		17.16	19.28	18.81	20.46	17.23	18.47	20.79	22.26	22.26

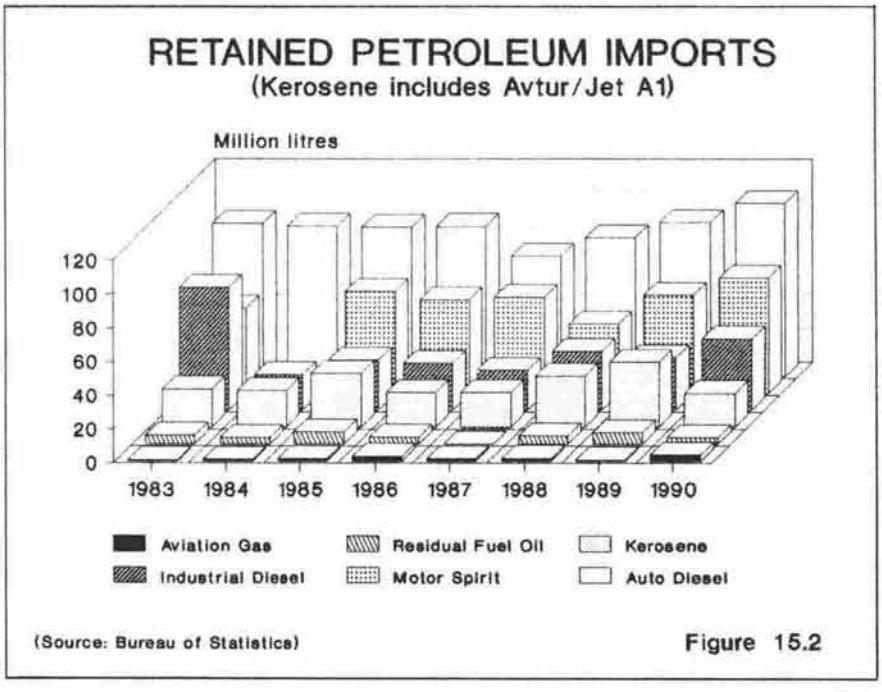


Figure 15.2

Figure 15.2 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 Monasavu 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.

15.3 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 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 increased steadily over the years with some fluctuations, notably a slowdown during 1987/88. Figures 15.3, 15.4 show 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.

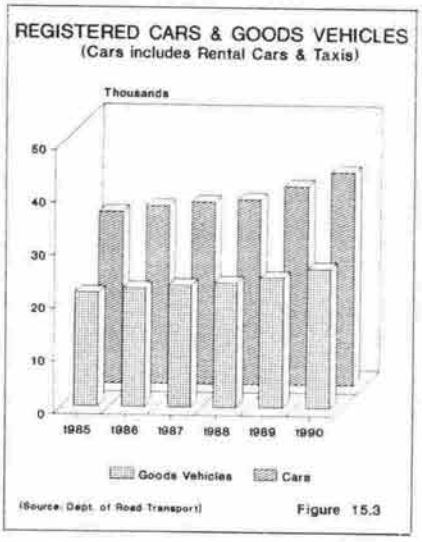


Figure 15.3

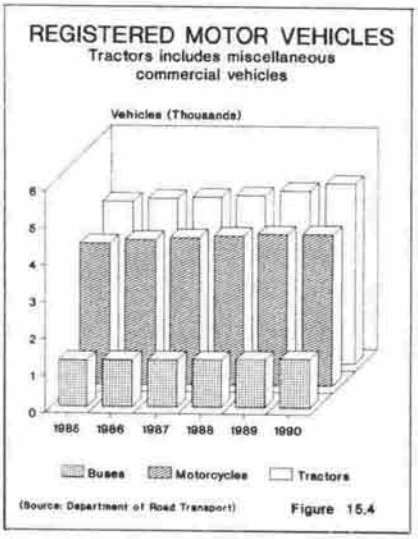


Figure 15.4

15.4 ELECTRICITY PRODUCTION

15.4.1 Background

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 Monasavu 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. Monasavu supplies 97% of all electricity in Fiji at no pollution cost. However, 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. Fortunately, 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.

About 43% of Fiji's households are connected to the FEA grid. Although there is considerable pressure to extend the grid further into rural areas the

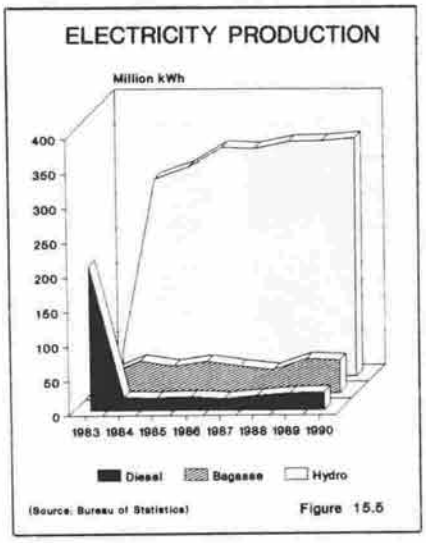


Figure 15.5

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 Monasavu 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 Monasavu came on line. Figure 15.5 shows the electricity production for the years 1983 to 1990.

15.4.2 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.

15.4.3 Hydropower

In addition to the main Monasavu scheme there are a few mini hydro-power systems either in existence or nearing completion. The largest (800 kW) is under construction by Chinese engineers at Wainikeu in Vanua Levu. Others include a 100kW system at Bukuya, a micro system at Tutu training center in Taveuni and a small system at Nosoqo in central Viti Levu. When completed, the Wainikeu project will be connected to 8 villages, the copra mill and to 300 consumers in Savusavu. The DOE has identified 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 hydropower being connected to the present Vaturu Dam water supply system, as one possible alternative.

15.5 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 around 350 kg per annum. In peri-urban and urban areas this value drops to 200 kg and 50 kg per annum respectively. In 1977, copra drying used approximately 150 kg per annum per capita in rural areas but because of low prices, output is reducing annually. 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 by-product. There are four mills operating: Lautoka, Rarawai, Labasa and Penang. About 95% of the bagasse is burnt 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 hydropower on the main grid and therefore little incentive to purchase. However, it is anticipated that soon after 1995, the era of surplus hydropower will have ended and FEA may purchase electricity from the FSC mills.

There has been limited interest in developing small scale biomass to electricity systems in Fiji. Several wood gasification plants were considered under the 1984 EEC energy program but none eventuated due to perceived difficulties with operating a relatively untested and new technology. Two small steam reciprocating engines exist in Taveuni, one on a copra plantation produces steam for copra and cocao drying and operates a 50kW 'Skinner' steam engine. The other plant is a smaller version operating a 10 kW Skinner steam engine in Navakawau village and also used for drying copra.

There are about 50 sawmills operating in Fiji, processing some 400,000 cubic metres of roundwood. With wastage during milling of the order of 50%, there is considerable potential for using the waste wood for energy production. In 1984 the FEA purchased a Fluidyne gasifier for evaluations. Subsequently they decided the technology was too problematic and the unit now sits idle at Vuda. One of the major operators, Tropic Woods, has 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.

There are about 50 sawmills operating in Fiji. With wastage during milling of the order of fifty percent, there is considerable potential for using the waste wood for energy production.

15.6 OTHER ENERGY SOURCES

15.6.1 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 regimein 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^2 exist, whereas in the wetter areas facing the prevailing weather they drop to around 14-15 Mj/m^2. The difference between summer and winter amounts to only around 6 Mj/m^2.

Due to the relatively high initial cost of photovoltaic (PV) systems, many in 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 limited success. Although nearly 200 radiotelephone systems are successfully run using PV systems.

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.

15.6.2 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.

A wind monitoring programme for power generation is currently being managed by the Department of Energy.

Savusavu Hot Springs.

15.6.3 Geothermal

There are about 40 known hotsprings 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. Evaluation of the geothermal energy potential is currently under way and initial results from Savusavu in Vauna Levu have been most encouraging.

15.6.4 Other sources

Ocean-based energy resources, such as wave power and OTEC, are readily accessible to Fiji but are not as yet proven. The DOE in conjunction with SOPAC are investigating the situation and participating in joint data gathering exercises with the Norwegian government and other agencies. A wave energy buoy is currently deployed south of Kadavu.

15.7 MANAGEMENT AND PLANNING IMPLICATIONS

Fiji has benefitted greatly from the commissioning of hydroelectricity from the Monasavu Dam. Industrial diesel oil imports dropped by two thirds saving about $170 million between 1983 and mid 1990 in reduced imports. A further $50 million was saved in the recent Gulf crisis. However, the construction of such a large project without any form of environmental impact assessment is a precedent which would be wise not to repeat. This applies to the possible use of the existing Vaturu Dam for hydro-electricity. 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 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 sawilling 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.

16 MANUFACTURING

16.1 GOVERNMENT POLICIES AND STRATEGIES

Recent changes in the direction of national economic policies focus on the manufacturing sector.

During the last two decades, development concentrated on processing output of the agriculture and fisheries sectors and on import substitutions. It is believed that the sector stagnated as the limits of development through import substitution were approached.

Current policies and strategies for the manufacturing sector emphasise:

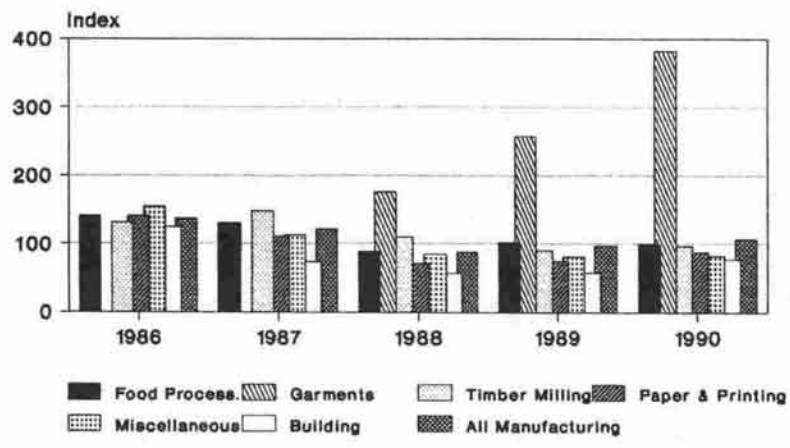
Deregulation
Tariffs are replacing non-tariff barriers to trade, protection is being wound down, and other regulatory systems are being reviewed.

Incentives and support infrastructure
Efforts are being made to boost domestic investment and attract foreign investment into the sector.

Trade and investment promotion
New markets and sources of investment are being explored, and exporting and importing skills developed.

Training
Manpower requirements are being assessed and training capacity upgraded.

Research and technology
International competitiveness requires that products made in Fiji meet market requirements in terms of design and quality.



(Source: Bureau of Statistics)

Figure 16.1

16.2 RECENT PERFORMANCE OF THE MANUFACTURING SECTOR

Figure 16.1 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.

16.3 ENVIRONMENTAL MANAGEMENT AND PLANNING IMPLICATIONS

Although there are obvious exceptions, current operations and developments within the manufacturing sector have no major adverse environmental implications. However, any expansion 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 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 is desirable and will require careful consideration and policy directives.

17 WASTE AND POLLUTION

17.1 INDUSTRIAL WASTE

Industrial activities in Fiji are varied and quite robust for a small country in an isolated location. Direct regulating control of water or air pollution and monitoring are absent. Because of this, there is a serious lack of data on the types and extent of pollution present in the country, in particular industrial pollution.

17.1.1 Tourism

Tourism is Fiji's largest industry and was estimated to have generated $350 million in 1990 (Chapter 12). 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. The quality of effluent is monitored by some of the larger hotels, but there is no monitoring of beach or lagoonal water quality in these areas. Smaller tourist facilities have septic tank systems, which are usually adequate, but expansion of such facilities has in some cases involved an undesirable density of such tanks.

17.1.2 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 km^2 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. Effluent from the mill is high in BOD and results in considerable reduction of dissolved oxygen levels in receiving water for the six months of the year that the mills operate. This undoubtedly causes damage to the aquatic environment, including fish kills. 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 criticism from neighbouring residents.

17.1.3 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% converted to 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, although this has now been changed to a dry process which is reported to generate no waste. Air pollution is generated by the burning of sawdust waste in the boiler to produce electricity. The treatment

plant is designed to contain spills of treatment chemicals but some of the older treatment plants are likely to be more polluting. Water pollution would result from run-off from the sawmill site carrying copper, chromium, and arsenic from stacks of treated wood and effluent. There are 19 other treatment plants in the country, each generating some copper, chromium and arsenic wastes.

17.1.4 Power generation

All Viti Levu's power requirements are now met, through the Monasavu Dam project, which resulted in the 'moth-balling' 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. [For further discussion of this issue see Chapter 15 - Energy].

17.1.5 Fish Processing

Fiji's major cannery is the PAFCO plant at Levuka. It is 99% owned by the Fiji 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 either much reduced or eliminated.

Solid waste from the plant is primarily waste metal from the tinplate manufacturing plant. Waste tinplate 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 cannery, Voko Industries at Laucala Beach, is a major complaint. Fish wastes in suspension are not treated before disposal. The cannery is effluent, which has a very high BOD, is discharged into the sewerage system, greatly taxing the Kinoya Treatment, already working at near capacity.

17.1.6 Mining

There is only one active mine in Fiji at the present time, the Emperor mine at Vatukoula. [This is discussed further in Chapter 13 - Mining.]

17.1.7 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 disgarded vehicle batteries in Walu Bay, should be considered a 'hazardous waste area' and because of on-going leaching of pollutants into the sea should be a high priority for mandatory clean-up.

17.1.8 Hazardous waste

There is virtually no information available on the generation, storage or disposal of hazardous wastes in Fiji and no specific regulations available to deal with the safe storage, transportation and disposal of this material. Existing laws and regulations are quite inadequate.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Hazardous wastes include materials which are corrosive, such as strong acids, alkali's and phenols; materials which pose a fire hazard during normal handling eg. hydrocarbons, solvents; reactive materials, which are liable to explode, generate toxic fumes or react violently with air, water, shock or heat, or toxic materials, ie those that are threatening to the life or health of people, plants or animals. Toxic materials include asbestos, heavy metals, cyanide, chlorinated hydrocarbons such as the organochlorine pesticides and PCB's; organophosphorus and carbamate insecticides widely used in agriculture and even in the home, infectious hospital wastes and many other chemicals and wastes.

The rate of generation of hazardous waste in Fiji is difficult even to estimate. In developed countries estimates of hazardous waste generation range from 12 to 28 kg per person per year, the average typically being around 16kg per person per year. Making the assumption that as a semi-developed country the rate for Fiji could be between one quarter to one half of this, ie 4 to 8 kg per person per year indicates that the total volume of hazardous waste requiring safe disposal per year would be in the range 3,000 to 6,000 tonnes per year. The actual amount of material, however, is less important than the state of current practice. There are no industrial waste treatment plants or hazardous waste landfills in Fiji, and therefore it must be assumed that virtually none of this materials is being disposed of properly.

The specific types of hazardous wastes being generated in Fiji will include but not be limited to the following:

- Pesticides, including pesticide wastes, obsolete chemicals, chemical containers etc; some are flammable and corrosive as well as being toxic, and it is likely that there are still large stocks of banned, withdrawn and out of date chemicals still in storage throughout the country;

- Chemicals used in forestry such as arsenous compounds, boron compounds and copper-chrome-arsenate sludges from timber treatment;

- Petroleum wastes and waste lubricating oils, which are toxic and contain large amounts of carcinogenic compounds, in addition to being inflammable; sediments and sludges from petrol and oil storage, frequently containing toxic tetra-ethyl lead;

- Asphaltic oils and tarry and bituminous wastes;

- Health, dental and hospital wastes, including many toxic chemicals, heavy metals and infectious materials;

- PCB's in some electrical transformers and most capacitors, including large ones in power stations and electrical substations as well as small ones associated with flourescent lighting.

- Asbestos-containing materials used in construction (for roofing, pipework, ceiling insulation, firewalls etc as well as for lagging around old steam and hot water pipes.

- A wide variety of chemicals used in industries of which the most common are the heavy metals (copper, lead, zinc, chromium, nickel, cadmium, mercury and arsenic) used in many applications such as metal treatment, corrosion protection, anti-fouling, leather tanning, clothes dyeing, printing etc etc; acids and alkali's; solvents and a wide variety of organic chemicals. Even a seemingly innocuous manufacturing operation such as gas-making results in large volumes of an alkaline sludge of calcium hydroxide which requires safe disposal.

At the present time safe disposal of hazardous wastes is not, in the main, occurring. There have been many examples of highly toxic materials simply being dumped on land or into the wtarecourses, contaminating surace water and potentially groundwater as well. Some of these chemicals are sufficiently toxic that they would be fatal to a small child ingesting them, and have the potential to contaminate foodstuffs as well.

17.2 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. Some of these, such as Nubukalou Creek, have been described as sewers rather than creeks [see Box 17.1].

Box 17.1 FAECAL COLIFORM COUNTS IN SUVA'S CREEKS

Average faecal coliform concentrations greatly exceed internationally acceptable standards in most if not all of Suva's creeks. While there is no absolute correlation between the level of faecal coliforms and the risk of illness or disease, studies have established a general relationship between the level of sewage pollution and the incidence amongst bathers of gastro-ntestinal illness.

Of particular concern is Nubukalou Creek which drains a major area of the city which is without sewerage. With faecal coliform levels thousands of times above an acceptable level it should be regarded as a sewer. The continued sale of fish along the creek bank with the consequent use of its water for washing them is a serious health hazard.

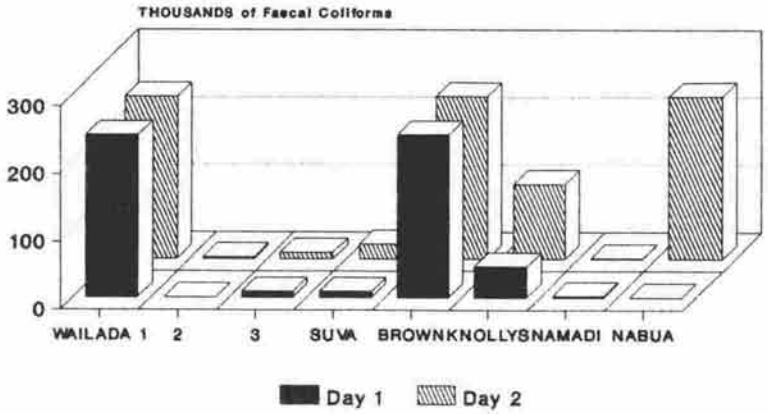


Figure 17.1

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

Table 17.1 : Sewerage facilities in some urban areas of Fiji

Town	Population (1986 Census)	Capacity of Sewage treatment plant (EP)	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

Also included in Table 17.1 is information on where the treated wastes are discharged. For Suva, in addition to the Vatuwaqa River discharge and the Kinoya outfall, there are sewage effluent discharges into the Wailada Creek at Lami and the Leveti Creek at Nasova. Monthly monitoring for bacterial concentrations in the vicinity of all the treatment plants is carried out by the National Water Quality Laboratory, at the Kinoya Sewage Treatment Plant. However, these data are not released to the public and are therefore not available for determining the status of the environment or the trends which are occurring.

17.3 SOLID WASTE MANAGEMENT

17.3.1 Garbage dumps

Virtually all urban areas in Fiji have problems with their solid waste disposal sites (see Table 17.2). 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 including, no doubt, pesticides used daily at the dump to control vermin, directly into the sea in an area heavily used for recreational and fishing purposes.

No municipal garbage dump in Fiji is managed to accepted international standards.

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.

Table 17.2 Fiji's municipal waste dumps

			Area		Land				
Place	Population (est.)	Dump present (1)	Type	Location	Owner (5)	Surf total (7)	In Use	Charge (8)	Remarks
Cities									
Lautoka	30 000	Yes	mangrove	next to river and urban area	State	15	3	Yes	burning, levelling, compaction, insecticide, no pollution recorded, maintenance access difficult
Suva (City)	75 000	Yes	mangrove	next to river, sea and town	State	5	all	Yes	burning, levelling, compaction, insecticide, dump is full, pollution of sea, river and air
Town									
Ba	8 000	Yes	forest	1km urban area, .5km village	State	5	1	None	burning, levelling, no pollution reported
Labasa	16 000	Yes	mangrove	close to river	State	4	2	Yes	levelling, waste covering, road upgrading, insecticide, no pollution reported except fly nuisance
Lami	not given	No (4)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	use of Suva City dump (located in Lami), complaints concerning bad maintenance of the site

Levuka (2)	8 200 (3)	Yes	mangrove	next to sea	NLTB	0.6	0.2	Yes	levelling & compaction, villages have private pits, smell and air pollution, lack of cover soil
Nadi	16 000	Yes	mangrove (shore)	next to sea	Private	1	all	Yes	compaction, levelling, no pollution reported, sea pollution suspected, shallow watertable, dump full
Nausori	5 000	Yes	forest/ swamp	next to river	State	1	1	Yes	levelling, insecticide, river pollution and smell, lack of cover material, cover problem along river
Savu-savu	4 000	Yes	mangrove	close to sea	NLTB	2.5	0.5	Yes	levelling, insecticide, no pollution reported
Rural areas									
Ba	60 000	No (4)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	individual households are burning and burying waste, some villages have communal pits
Labasa	10 000	No (4)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	use of Ba town dump
Lautoka	not given	No (4)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	use of Lautoka city dump
Nadi	60 000	No (4)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	use of Nadi town dump
Nausori	60 000	No	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	private individual pits encouraged, some villages have communal system
Navua	25 000	Yes	mangrove	100m from sea	State	1	0.2	Yes	levelling when funds and machinery are available, smell and fly nuisance are reported
Rakiraki	5 000	Yes	mangrove	near sea	State	2	0.2	Yes	levelling, compaction and use of insecticide, lack of covering material and machinery
Taveuni	7 000	No	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	dumping in communal and individual pits
Tavua	33 000	Yes	depression		Private (6)	2	1	Yes	levelling, no treatment of waste, no pollution reported
Suva	70 000	No (4)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	use of Suva City dump

n.a. = not applicable
(1) = is a dump present, owned or leaded by the authority
(2) = data obtained from the Rural Local Authority
(3) = population of the total island of Ovalau
(4) = dump of the nearby town or city is used
(5) = NLTB : Native Land Trust Board
(6) = owned by Vatukoula Gold Mine
(7) = approximate area in ha
(8) = charge included in the city or town rate

Source: Mineral Resources Department.

Another example of poor waste management is the Nausori dump, which is located on the bank of the Rewa River. The dump, which is upstream from the town, pollutes the river through leachate and runoff, 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, Table 17.2. This is not a result of being unable to secure other sites, rather that mangrove areas being state land does not have to be negotiated neither does it 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 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 levy fines.

17.3.2 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 environmental 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.

Air pollution

Principal atmospheric pollutants from stationary sources in Fiji are:

- Dust from quarries, asphalt plants, cement mills, stone crushers, furniture making and road dusts from vehicles.

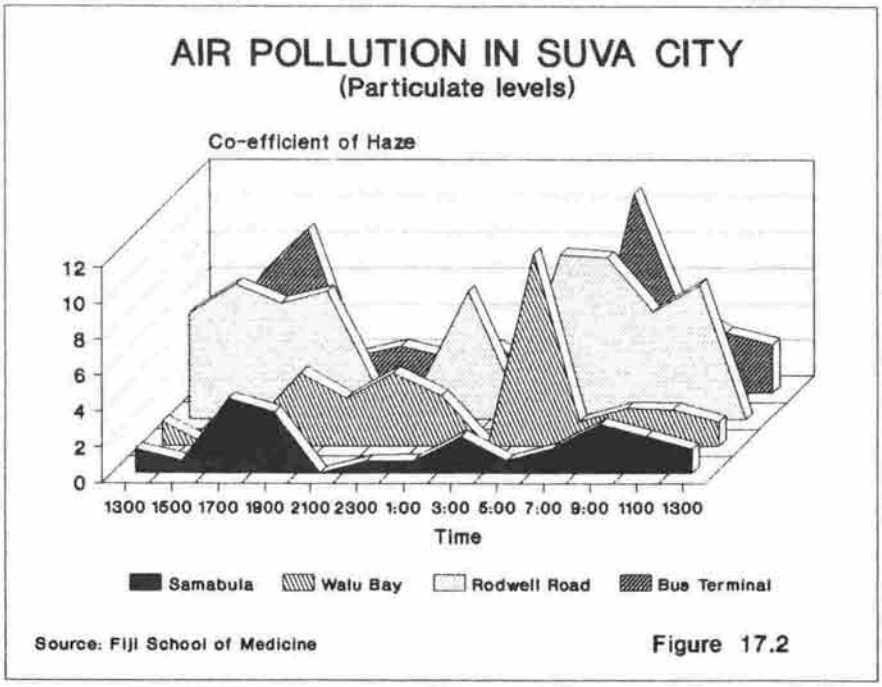


Figure 17.2

- 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 mills and timber mills.

There is no regular monitoring of air pollution and even data from spot-checks are fragmentary. The latter indicate that levels of dust and particulates can be high in certain locations such as the Suva Bus Terminal. In so far as can be determined from such paucity of data, 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.

Noise levels

Noise pollution in Fiji includes the following sources:

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

As with air pollution, there is no monitoring of noise levels. Spot-checks indicate 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.

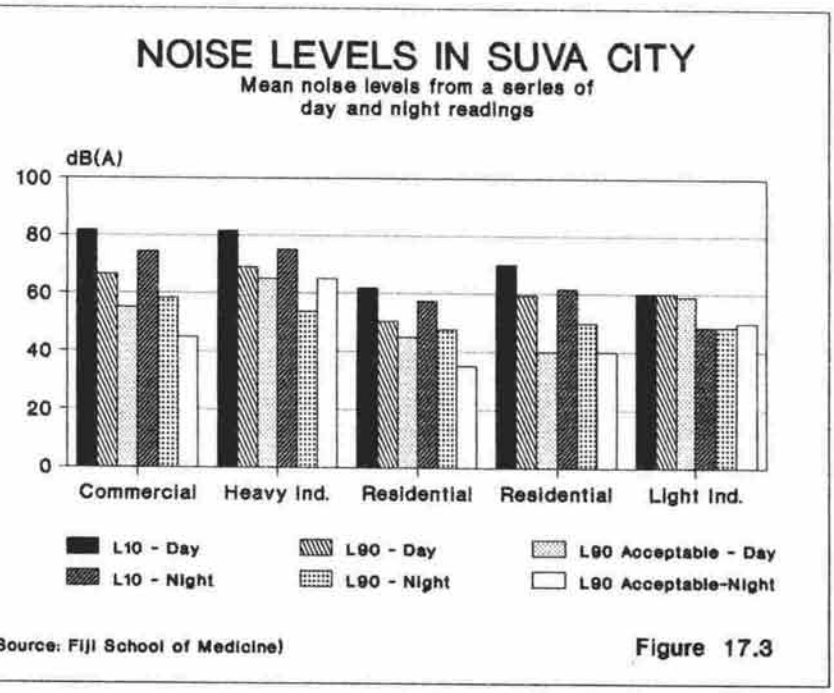


Figure 17.3

17.3.3 Litter

Public awareness of litter is relatively low 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 in the water. Although this may be a perfectly effective method of dealing with food wastes, it is not suitable 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 about 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 way the World Should Be' will become an empty boast if Fiji is perceived as a place where beaches are fouled with litter.

17.3.4 Recycling waste

With the exception of certain bottles, and the recently established Tiko Industries operation, there is no significant recycling of waste in Fiji. The major reason is the insufficient quantity and the dispersed distribution of the waste which makes it uneconomical to invest in a recycling plant.

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

17.4 PESTICIDES

17.4.1 Usage

Fiji imports approximately F$1,900,000 worth of pesticides annually, (see Table 17.3).

Table 17.3 Value and volume of imported pesticides (includes a proportion that are re-exported).

Pesticide	1989 F$	1989 Kg	1990 F$	1990 Kg
Pesticides [1]	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

1. Included here: Insecticides, rodenticides, nematicides, fumigants.

While the total figures in Table 17.3 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 are now no longer used. 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 17.4.

Table 17.4 List of most commonly used pesticides.

PESTICIDE	Hazard class[1]	Crop use	Remarks
Herbicides			
2.4.D	Moderately	Sugar cane	Often sold mixed
asulam	Very low & veg.	Sugar cane	with other active ingredients.
dicamba	Very low	Sugar cane	
ioxynil	Moderately	Sugar cane	
MCPA	Slightly	Rice	
paraquat	Moderately	Veg., plantation & Sugarcane, Rice	This and 2,4. D are the most used
propanil	Slightly		
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

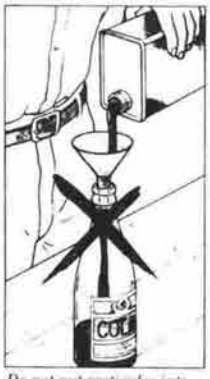
1. Hazard Class: Follows the WHO recommended classification of pesticides by hazard.

A range of household insecticides are retailed throughout Fiji; the main active ingredients are propoxur, pyrethrins and pyrethroids. None gives 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, bromadialone, diazinon, difenacoum, d-phenothrin, malathion and propoxur. All are in the moderate to slightly hazardous catagories.

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

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



Do not put pesticides into drink bottles.

Burn or bury empty containers.

Box 17.2 *BIOLOGICAL CONTROL*

Can you name the scientific discipline for which Fiji is known all over the world? It's Biological Control, keeping down pests by using their natural enemies rather than chemicals. The task your cat does ..... exterminating the household rats and mice.

Fiji's copra industry owes its very survival to the biological control of not one pest but at least five. One of these was so successful that the pest, the attractive levuana moth, is probably now extinct. Another pest, the coconut spike moth was under control in Fiji fifty years ago, and it was to Fiji that the experts recently came to carry the successful predator to the Philippines, the giant of the copra world. The occasional rhinoceros beetle is still seen, but its members are severely depleted by a viral disease from Malaysia.

When we spend time and money killing insects indiscriminately with chemicals, it is as well to remember that there are other more environmentally acceptable ways.

17.4.2 Supply

Several companies import ready-formulated pesticides and these companies are also the main retailers. One company, 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 in particular, acephate and paraquat are also obtained from less well known sources in S.E. Asia and Taiwan.

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.

17.4.3 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

Box 17.3 *INTERNATIONAL ASSISTANCE TO NATIONAL PESTICIDE MANAGEMENT*

In 1989, SPC/FAO sponsored a workshop for Pacific Island countries on the implementation of the FAO International Code of Conduct on the Distribution and Use of Pesticides. Fiji was represented by the Registration Officer. The workshop recommended that Governments of Pacific island countries take steps, within their capabilities, to implement their responsibility under the Code.

The Code describes the shared responsibility of many segments of society in the distribution and use of pesticides. It seeks to establish voluntary standards for all public and private bodies involved with pesticides.

Within the Pacific region the South Pacific Commission Plant Protection Service (SPC-PPS) promotes the Code and provides a service of training and assistance in all aspects of plant protection.

The International Association of National Trade Associations for Manufacturers of Agrochemicals (GIFAP) has issued a much acclaimed series of pictorial 'Guidelines' and posters for the safe management of pesticides. The SPC-PPS has distributed copies of these to all its member countries.

The Extension Service of the Ministry of Primary Industry provides farmer training in all aspects of crop production, including the safe and efficient use of pesticides. Plant protection research staff routinely assist on these courses. This is a continuous task as the pesticide safety message needs frequent reinforcing.

Staff of the larger pesticide suppliers and retailers receive regular product knowledge training. This includes proper storage practices, toxicity, first aid and safe and efficient use. It is not known what kinds of training the small retailers receive. Under the FAO Code of Conduct it is a responsibility of industry to see that this is done.

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.

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.

'Dumping' 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; and
- the market is very small.

A recent pesticide sector review (Lunn 1989), 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.

Apart from some training for the Registration Officer none of these recommendations have been implemented.

The review concluded that while the present system is administered 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.

17.4.4 Accidents with pesticides

Pollution and waste disposal are issues of grave national concern.

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. Pollution must also occur from runoff and the incorrect washing of equipment and improper disposal of unused pesticides. However, no monitoring for pesticides has ever been carried out in Fiji, so the extent of this, and its effects are unknown. All these stem from a lack of knowledge and care in use. One widespread practice of particular concern is the use of an insecticide in small streams and creeks to obtain freshwater prawns. Many of the prawns caught in this manner are sold at the roadside. Enhanced retailer and farmer training, and public awareness campaigns rather than legislation are required to counter these.

17.5 MANAGEMENT AND PLANNING IMPLICATIONS

Pollution and waste disposal are issues of grave national concern not so much because of the known or suspected threats to human health and safety, but because the issues are being effectively ignored or mismanaged.

There are several reasons for this, including the lack of appropriate regulations, absence of monitoring data and lack of national standards. But, overall there is a lack of government direction and initiative.

There is an urgent need for the following:

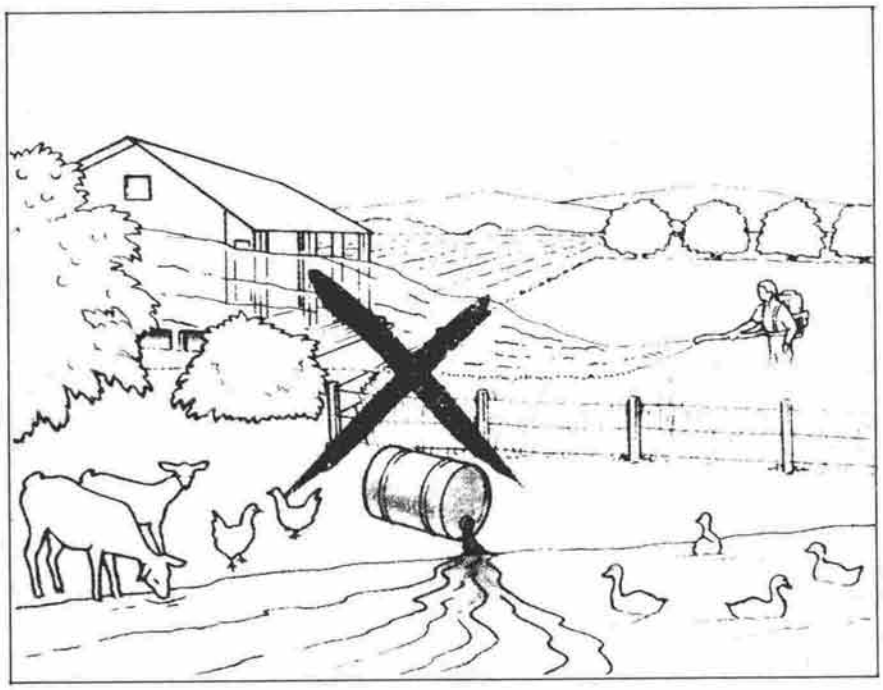
- A national inventory of pollution sources, including particularly the nature and volume of hazardous wastes, so that the scale of the problem can be determined, priorities identified and environmental monitoring properly targeted.

- Legislative framework for management of waste and pollution, including emission standards, water quality guidelines, ambient air quality targets and procedures for the identification and treatment or disposal of hazardous wastes.

- Institutional framework for waste management and enforcement of regulations.

- A national environmental monitoring programme, supplementing existing monitoring programmes and focussed on the key areas of concern, especially the cities and large towns, industrial estates, tourist areas, agricultural and logging areas.

Pesticide use is a hazardous occupation which needs effective communication with the users. Legislation alone will be ineffective. As a small nation, Fiji is in a very difficult situation with respect to the control of pesticide registration and quality. It is too large and expensive a task for Fiji to undertake all the elaborate trials and tests for national registration of the many products brought out each year. Yet neither is blindly following standards or the lead of other countries always beneficial.



LEGAL AND INSTITUTIONAL FRAMEWORK

18 ENVIRONMENTAL POLICY IN NATIONAL DEVELOPMENT AND INTERNATIONAL RELATIONS

18.1 DEVELOPMENT PLANNING 1971-1991

Fiji has engaged in some form of development planning since the end of World War 2. The planning was used as an instrument for 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 basis Fiji formulated its first Development Plan for the ten 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).

No development plans have been prepared since DP9 following the Government's decision to follow the path of deregulation and a policy decision to promote economic growth through increased private sector development. However, in 1989 the Government convened a National Economic Summit, subsequently producing the document, **'Policies and Strategies for the Short and Medium Term'**. This was repeated in 1991 with the production of a **'Review of Performance and Prospects'** of Fiji's economy.

Development plans are a blueprint of a country's cross-sectoral policies, strategies and programs for a given period. It is therefore worth tracing the development of national environment policies within the plans and evaluating the extent of their implementation as part of this 'State of Environment' review. The present state of the environment is, after all, largely a result of the past national development planning process.

18.1.1 DP6 (1971-75)

This development plan was the first prepared following Independence. The plan had no specific section on environment but contained statements on resource use/environment issues which, 20 years later, could be regarded as prophetic. Specifically:

Agriculture

'It is in the national interest that arrangements for the use and occupation of the limited agricultural lands of Fiji be designed to preserve and develop their productivity, to guard against erosion and to encourage working them in such a manner that productivity increases rather than falls'.

Forestry

'... more control of felling is needed in order that forest resources are not prematurely exhausted'.

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'.

18.1.2 DP7 (1976-80)

In terms of national environmental policy DP7 was 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 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 of 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 Ministeries 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 - see box 8.1).

Energy

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

18.1.3 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 1992. 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 .....'.

18.1.4 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 steepland cultivation, due to over-grazing or over-stocking, uncontrolled burning of grassland and cane trash, steepland logging, construction of new roads, land excavation for sub-division, 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 ensure 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 (see Table 18.1). 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.

18.2 RECENT POLICIES AND STRATEGIES

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

Table 18.1 DP9 INDICATIVE EXPENDITURE FOR ENVIRONMENT MANAGEMENT PROGRAMME ($000, 1985 PRICES)

Programmes	1986	1987	1988	1989	1990	Total
Environment Management Committee						
1. Environment Management Unit	25	43	54	59	64	245
2. Environment Protection Legislation		20	2			22
3. Coastal Zone Management Plan		50	50			100
4.Environment Impact Assessment Procedures for Fiji		2				2
5. Sigatoka Sand Dunes Reserve	1	1	1	1	1	5
Sub-Total	26	116	107	60	65	374
National Trust for Fiji						
6. Organisational Structure	78	215	225	234	115	867
7. National Conservation Strategy	72	4				76
8. Historic Site Survey		30	10			40
9. Environmental Education Programme	25	17	15	25	15	97
10. National Parks and Reserves System	16	45	20	50	50	181
11. Momi Guns Historic Park and Military Museum	4	9	4	4	4	25
Sub-Total	195	320	273	313	184	1,286
Total	221	436	380	373	249	1,660

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 more fully emphasised in national development policy. Also important was recognition of the need for a multi-sectoral approach in implementing 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.

Effective support for environmental planning and management is likely to yield high economic benefits.

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).

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

This review largely reproduced the sentiments of the 1989 report. One important difference was the inclusion of the following statement on envi-

ronmental 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.

[Box 18.1] *INTERNATIONAL ENVIRONMENTAL / RESOURCE CONVENTIONS TO WHICH FIJI IS PARTY (DATE: YEAR OF FIJI'S ENTRY)*

- International Plant Protection Convention (1956)
- Convention on the Continental Shelf (1970)
- Convention on the High Seas (1970)
- Convention on Fishing and Conservation of the Living Resources of the High Seas (1971)
- Plant Protection Agreement for South East Asia (1971)
- Treaty Banning Nuclear Weapon Tests in the Atmosphere, Outer Space and Underwater (1972)
- Treaty on the Non-proliferation of Nuclear Weapons (1972)
- International Convention for the Prevention of Pollution of the Sea by Oil (1972)
- Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological and Toxic Weapons and their destruction (1973)
- International Convention Relating to an Intervention of the High Seas in Cases of Oil Pollution Casualties (1975)
- International Convention on Civil Liability for Oil Pollution Damage (1975)
- South Pacific Forum Fisheries Agency Convention (1979)
- United Nations Convention on the Law of the Sea (1982)
- International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (1983)
- South Pacific Nuclear Free Zone Treaty and Protocol (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 their Related Protocols - the SPREP Convention (1989)
- Convention Concerning the Protection of the World Cultural and Natural Heritage - the World Heritage Convention (1990)

18.3 INTERNATIONAL CONVENTIONS AND INTERACTION

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

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 these donors and lenders now require environmental assessments of proposed projects as a pre-condition of granting aid or loans for development.

18.4 CONCLUSION : POLICY OR PRACTICE?

The first development plan, DP6, reviewed in this chapter identifies the key resource management issues of soil, water, and vegetation conservation as a basis for maintaining economic productivity. In one form or another these sentiments have been repeated in all the following development plans spanning the last 20 years. Yet, the condition of the country's critical environmental resources continue to decline. Although some progress has been made (most in the last three years, see Table 18.2) generally there has been a marked lack of implementation of strategies and programmes specified in the plans.

The reasons for this can be attributed to:

- lack of integration of development and environmental policies;
- scattering of environmental laws in numerous acts and environmental responsibilities at the administrative level;
- inadequate expertise and resources; and
- the predominance of economic and social development goals in national decision making which are isolated from any environmental framework.

The best environmental policy formulated and/or adopted at both national and international levels will be meaningless if implementation strategies are not enacted through provision of funds and technical resources. Above all, sustainable development will not be possible until environmental planning

and management implementation strategies are closely linked with those for national economic development in a cross-sectoral manner. A good start to such an approach, for example, would be the inclusion of environmental implications and justification on the forms used for new project expenditure submitted by ministeries/departments to the Ministry of Finance and Economic Planning. Currently the forms are entirely economic and socially oriented in terms of project justification.

Table 18.2 Environmental Planning & Management in Fiji: Policy and Implementation 1976-1990

YEAR	ENVIRONMENTAL POLICY/COMMITMENT/ACTION	COMMENT
1976	Comprehensive environmental planning and management objectives and programme proposed in Development Plan 7 (1976-1981) including concepts of a national policy and advisory council.	Not acted upon during DP period
1980	1. Establishment of the interministerial Environmental Management Committee under the chair of the Director of Town and Country Planning. 2. Establishment of Fiji's first wildlife sanctuary:the Crested Iguana Sanctuary on Yadua Taba Island.	1. Still operative 2. Requires management and research
1981	A system of national parks proposed in Development Plan 8; proposal to enact a National Parks and Reserves Act; additional support to National Trust.	Not acted upon.
1982	1. New Zealand expert commissioned to draft formal EIA procedures. 2. Approval by Public Service Commission to establish Environmental Management Unit (EMU) within Department of Town and Country Planning.	1. Procedures operational 2. Not acted upon.
1983	Establishment of Mangrove Management Committee	Still operational
1985	Preparation of national Mangrove Management Plan Phase - 1	Endorsed by Government.
1986	1. Development Plan 9 proposes comprehensive national environmental planning and management objectives. 2. Preparation of national Mangrove Management Plan Phase 2. 3. Registration of archaeological sites by the National Trust of Fiji.	1. Some objectives implemented in 1989/90/91. 2. Not yet endorsed by Government 3. Not acted upon.
1987	Public Service Commission approval to advertise EMU's principal officer position.	
1988	1. Advertising of EMU principal officer position. 2. Argricultural Diversification Loan Programme agreed to between Government and Asian Development Bank, including a condition to establish EMU. 3. Establishment of Fiji's first national park: Sigatoka Sand Dunes National Park 4. FAO Forestry Sector review completed.	1. No locally qualified personnel. 2. Negotiations between Ministry of Primary Industries, Ministry of Finance and Economic Planning & ADB 3. Requires management & development. 4. About 75% of recommendations implemented.
1989	1. Appointment of expatriate environment specialist to EMU principal officer position. 2. Cabinet agreed to accept an ADB Technical Assistance Grant to prepare a National Environment Stategy. 3. National environmental policy and strategies paper endorsed by National Economic Summit. Other sectors included environment policies in their sectoral policy papers. 4.Government acceded to the Convention for Conservation of Nature in the South Pacific.	1. EMU operational: increased level of project environmental assessment and development of Government Policy

	5. Government acceded to the Convention for the Protection of Natural Resources and Environment of the South Pacific and Related Protocols. 6. Government signs the Vienna Convention and Montreal Protocols on Substances that Deplete the Ozone Layer. 7. Cabinet agreed to pruchase a section of freehold coastline to establish a National Coastal Park for community recreation. 8. Cabinet agreed to accede Convention Concerning the Protection of World Cultural and Natural Heritage (World Heritage Convention).	2. Subject of negotiation
1990	1. Commencement of National Environment Strategy Project 2. Government ratified World Heritage Convention.	1. Due to be completed in August 1992.
1991	1. Ministry for Housing and Urban Development agreed to establish a Committee to oversee phasing out of CFC use. 2. Environment Unit prepared National Report for UN Conference on Environment and Development 3. Marine Department establishes National Oil Pollution Committee 4. National Environment Management Project prepares 'State of the Environment' Report. 5. Anti-Litter Decree gazetted 6. Environment Unit separated from Department of Town and Country Planning and established as a separate function of Ministry of Housing and Urban Development.	1. To comply with obligations under the Montreal Protocol.
1992	1. Ministry of Housing and Urban Development establishes Consulative Committee on Ozone Depleting Substances (as per 1991 - 1 above). 2. New Anti-Litter Laws come into force.	

19 ENVIRONMENTAL LAWS AND ADMINISTRATION

19.1 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 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 19.1. What is immediately apparent from the table are the insignificant penalites 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, and the polluter does not have to pay! The future must lie in legislation which binds the polluter (or forester, farmer, miner etc.) to clear up any mess he/she causes.

Currently it is the Town Planning Act 1946 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/she believes appropriate or necessary under the circum-

stances. 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 are the property of the State and are 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 involves 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.

Table 19.1 Fiji's environmental laws

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 sylviculture areas in reserved forests and declare native land to be Protected Forest	Max fine $300 and /or 6 months imprisonment	Conservator of Forests & Ministry of Forestry
Town Planning Act 1946 (Cap139)	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 infringement	Director of Town & Country Planning & Ministry of Housing & Urban Development
Native Land Trust 1940 (Cap 134)	Can lease Native Land (which is not Native Reserve land) with restrictions regarding land use.	Civil Remedies	Native Land Trust Act 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 (Act 141)	Land Conservation Board may make 'Conservation Orders' Contravention of such an 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 Monuments'. Preservation of Monuments.	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	Max fine $50 and/or 3 months imprisonment	Ministry of Primary Industries
	Non Fiji registered fishing vessel without Licence.	Max fine $100	
	Use of dynamite.	Max fine 12 months and/or $200 fine	
Fisheries Regulations 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 '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 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 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 of Primary Industries
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 Infrastructure and Public Utilities
Public Health Act 1955 (Cap 111)	Board may cause inquiries to be made. Person authorised in writing may enter premises Power to inspect water and sewerage works.		Central Board of Health (Ministry of Health)
	Various powers to abate nuisances:- Inspection of district to ascertain nuisances.		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

19.2 LAWS OF LAND AND RESOURCE USE

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

While there are loopholes in both the Forests and Land Conservation and Improvement Act , 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, 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. Although the Board has wide powers, 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 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 custodian 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.

19.3 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 the most conspicuously enforced. Clamp-downs on the sale of undersized produce and prosecution of users of dynamite, for example, are regularly reported. Nonetheless although Fisheries Department personnel believe these efforts should be greatly increased, they lack the necessary resources.

Some of the stiffest penalties are to be found in fisheries associated legislation (Table 19.1). 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.

19.4 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 'season').

Box 19.1 - *FULL PROTECTION FOR FIJIAN PARROTS*

Fiji has five species of parrot, all of which are of great cultural and scientific value. The kula and the kadavu parrot are perhaps the best known. All Fijian parrots (and all native birds) are fully protected by law and their capture, confinement and export is prohibited.

No parrot may be held in captivity without a permit, a law which is conspicuously flouted. This practice encourages the robbing of parrot nests for their young, many of which die long before they reach urban areas where the majority of captive parrots are kept in poor conditions with an inadequate diet.

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.

No parrot may be held in captivity without a permit, a law which is conspicuously flouted.

For the conservation of historical artifacts of any nature the National Trust of Fiji Act 1970 and the Preservation of Archaeological and Palaeontological Interest Act 1940 have very wide powers and possibilities. However, only one National Monument, Wasavulu near Labasa, has ever been declared (Box 20.3). Recent moves by the Department of Town and Country Planning have initiated protection of historic buildings through planning regulations, (20.5).

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.

19.5 LAWS OF FRESHWATER USAGE AND ITS POLLUTION

Legislation controlling freshwater usage - from rivers or streams dates back to the Rivers and Streams Ordinance of 1882 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 watershed management programmes

are to be effectively implemented. While this has not hitherto been an issue of concern, modern requirements for water diversion or consumption are increasing rapidly, not just in number but in scale.

19.6 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 practically impossible and has never been carried through. Thus, some of the most blatant offenders, such as the Bandag car battery plant at Walu Bay, 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 forms of pollution such as smoky vehicle exhausts could be prosecuted, given sufficient political directive and resolve.

All petrol sold in Fiji contains lead additives and there is no programme in place for gradual conversion to lead-free petrol, despite the fact that unleaded petrol is widely available elsewhere in the world.

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.

An Anti-litter Decree has recently been introduced.

19.7 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 inter-ministerial 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 primarily into an advisory and coordinating role with the main function of advising 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 is that Government agencies do not have to comply with the statutory development approval process. 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 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 Fiji 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 a principal environmental specialist until 1989. This principal position (occupied by an expartriate 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. In October 1991, the Unit was established as a separate entity within the Ministry of Housing and Urban Development. 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 inter-ministerial 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 environment issues has multiplied considerably (Box 19.2).

The formation of these committees largely reflects the sectoral nature of environmental responsibilities. It also indicates growing recognition of

environmental problems and issues. Although there is an obvious need for specific committees to resolve these issues or problems there is a danger that, without overall coordination, their formation will continue to support through inaction, the country's compartmentalised approach to environmental management.

Box 19.2 *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 on the environmental implications 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 (MHUD)

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.

- NLTB Steering Committee

The development of the landowner tourism forest parks at Waikatakata and Bouma necessitated formation of committees to oversee the successful implementation of the projects. Government and landowner representation.

- National Environment Steering Committee (MHUD)

This committee was established to oversee 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.

- Consultative Committee on Ozone Depleting Substances (MHUD)

This Committee has been 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.

There is a clear need for effective central coordination of national environment initiatives. Although the EMC originally had this task it has proved ineffective, 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 it will be viewed as yet another ad hoc Ministry of Housing and Urban Development (and therefore largely sectoral) committee by other line ministries. This will tend to provide representation at senior technical level rather than at 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 thus free it from its current sectoral compartmentalisation.

19.8 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, is 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.

20 PROTECTED AREAS AND NATIONAL PARKS

20.1 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 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.

20.2 THE EXISTING RESERVES AND PROTECTED AREAS

20.2.1 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 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.

20.2.2 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.

Box 20.1 - *BATIWAI PROTECTED FOREST*

The Batiwai Protected Forest was proclaimed in 1956. With an area of 15,750 ha of rugged lowland rainforest, it would be an ideal conservation area for this threatened forest type. In addition it encompasses the world's entire range of the little known palm *Gulubia microcarpa.*

However, nearly the entire Protected Forest has been given out in a logging concession and the logging is almost complete.

The Ministry of Forests also recognises an additional management classification of relevance but without 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.

20.2.3 Other protected areas

Several other categories of protected areas exist (Table 20.1). Of major ecological significance are the Garrick Memorial Park (400 ha) which has been extensively logged (see Box 20.2), 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.

Box 20.2 *THE GARRICK PARK DEBACLE*

> ' In a magnificent gesture of philanthropy, the Garrick family has given a vast tract of land containing some of the finest tree species of the native forest to the National Trust to be used as a Park Reserve..... the Garrick family's decision was motivated by two considerations. One was their concern at the depletion and ravaging of native forests by logging companies ..... The other consideration was the Garrick family members' genuine desire to do something meaningful for the country which has given them the opportunity to live, work and prosper '.
>
> **[Fiji Times - Editorial - 3/8/84]**

Five years later, massive logging of long-standing was discovered within the Garrick Park - The Ministry of Forests and Native Land Trust Board immediately and publicly denied that any illegal logging had taken place. An independent surveyor verified the logging incursion but he was not believed.

Two years later the boundary of the Park, which was fully and professionally surveyed but whose boundary had been allowed to become overgrown, was again demarcated this time by a Government surveyor, and the original claim of the logging incursion found to be correct.
The incursion appears to have never been officially investigated, nobody held responsible, and no compensation sought or paid. Not even the National Trust reported to the nation.

But the debacle continued .....

The Garrick Park is part of a watercatchment of a $5 million dam and rice irrigation scheme. Hydrological data showed that the scheme would be short of water during dry spells, so water supply was vital hence full protection of the catchment essential. A management plan for the Garrick Park had identified this and proposed an extension of the Garrick Park for the dual purpose of protecting the water supply and providing a nature and amenity park.

A year after the plan was published, the catchment was being logged with access to the site through the Garrick Park being condoned by the National Trust for Fiji.

Given this course of events it is, perhaps, not surprising that the Fiji public still has no opportunity to enjoy the fruits of the philanthropic gesture of the Garrick family. There are no public amenities or provisions for easy access. There are, however, a few trees left and the Park remains a potentially important conservation area, though a mere shadow of its former majesty.

Of major significance is the recent opening of the Tavoro Forest Park at Bouma 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.

Table 20.1 Fiji's Protected Areas

Protected Area Status	Year of Establishment	Location	Type of Feature	Tenure	Area (ha)	Administration
National Parks						
Sigatoka Sand Dunes National Park	1988	South West Coast Viti Levu	Sand Dunes, Beach Forest Archaeological Site	State Native and Freehold	240	National Trust for Fiji (State Land Only)
Nature Reserves						
Ravilevu	1959	Taveuni Island	Rain Forest	Government	4020	Ministry of Forestry
Naqarabuluti	1958	Viti Levu	Rain Forest	Goverment	279	Ministry of Forestry
Draunibota and Labiko Islands	1959	Suva Harbour Viti Levu	Recreation	Government Government	2.16	Ministry of Forestry
Nadarivatu	1956	Viti Levu	Dakua Forest	Government	93	Ministry of Forestry
Tomaniivi	1958	Viti Levu	Rain Forest	Government	1322	Ministry of Forestry
Vuo Islands	1960	Suva Harbour Viti Levu	Coastal Islet		1.2	Ministry of Forestry
J H Garrick Memorial Forest Reserve	1986	Southern Viti Levu	Forest	Freehold	428	National Trust for Fiji
Namenalala Island Nature Reserve	1984	South of Vanua Levu	Sea Bird Colony Barrier Reefs	Native	43	Lesee/NLTB
Forest Park and Amenity Areas						
Colo-i-Suva	1952	Suva, Viti Levu	Forest/ Stream	Native	91	Ministry of Forestry
Lololo	Early 1970's	Western Viti Levu	Forest/ Stream	Native	0.5	Fiji Pine Commission
Tavakubu	Early 1970's	Western Viti Levu	Pine/Forest /Stream	Native	1	Fiji Pine Commission
Bouma Forest Park	1991	North Taveuni	Waterfalls/ Rainforest	Native		Landowners with Ministry of Forestry/NLTB
Waikatakata Forest Park	(in process)	South Viti Levu	Rainforest/ Archaeology	Native		Landowners with Ministry of Tourism/NLTB

Tavuni Hill Fort	(in process)	South Viti Levu	Archaeology	Native	20	Landowners with Ministry of Forestry/NLTB
Saweni Beach	Early 1970's	Western Viti Levu	Beach	Native	0.5	Ministry of Forestry
Lomolomo	Early 1970's	Western Viti Levu	Beach	Native	0.5	Ministry of Forestry
Nukulau	Early 1970's	Off Suva Viti Levu	Island and Reef	Government		Department of Lands
Wildlife Sanctuary						
Yadua Taba Island Crested Iguana Reserve	1981	Western Coast of Vanua Levu	Island Sanctuary For crested iguana	Native	50	National Trust for Fiji
National Archaeological Monument						
Wasavulu		Near Labasa, Vanua Levu	Cultural Site	?	??	National Trust for Fiji and/or Fiji Museum

Source: NLTB with additions by NEMP

20.2.4 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 State 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.

20.3 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 also appear to have no better prospect for implementation.

A major drawback is the lack of a 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 (see Box 20.2) other organisations such as the NLTB, MOF and MOT 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 among these are:

- Wabu Creek, Viti Levu;
- Sovi Basin, Viti Levu.

20.4 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, (see Box 20.3).

20.5 ARCHAEOLOGICAL AND HERITAGE SITES

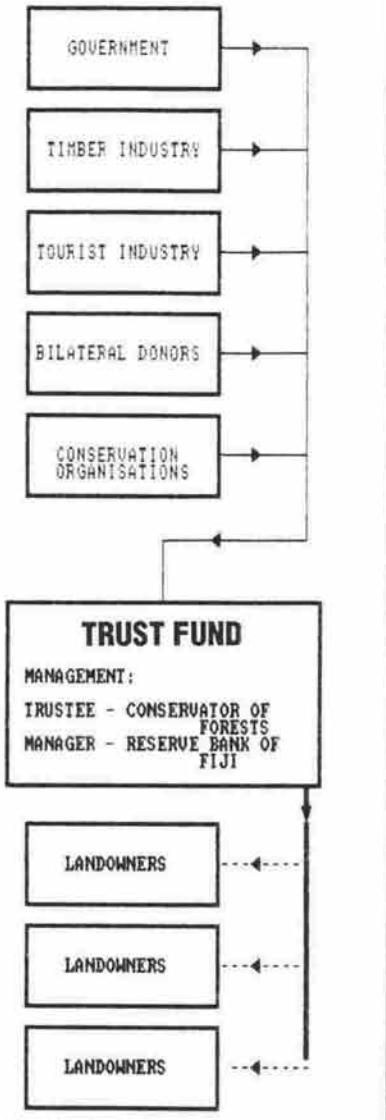
20.5.1 Archaeological and historic sites of cultural importance.

Fiji has a sole declared National Archaeological Monument -Wasavulu in Vanua Levu, (Box 20.4). 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

Box 20.3

COMPENSATION FOR FOREGONE ROYALTIES: A TRUST FUND



PAYMENT FORMULA:

$$a = \frac{X_0 \cdot i}{1-(1+i)^{-N}}$$

where, X_0 = foregone part of royalty to be paid over time

i = discount factor
N = number of years
a = annual compensation

SCOPE OF THE FUND:

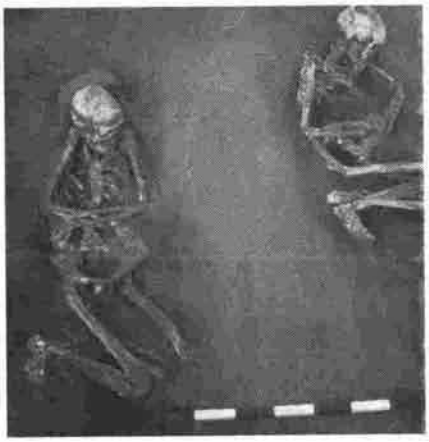
The scope of the fund could be widened to include desirable developments in pursuit of preservation, conservation or National Parks.

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-interpretion. To date his work has covered the Rewa and Navua Deltas, the Sigatoka Valley and (as yet unpublished) west and north Viti Levu.

Box 20.4 *WASAVULU, FIJI'S SOLE NATIONAL ARCHAEOLOGICAL MONUMENT*

Fiji has only one declared National Archaeological Monument, Wasavulu near Labasa. A site of unknown significance or original function, Wasavulu lies sadly neglected. In the absence of any protective management, indeed it is even unclear which is the managing authority - the Fiji Museum or the National Trust for Fiji, and despite the presence of traditional custodians who are living adjacent to the site, the central monolith was broken 'during land clearing' by a falling coconut palm and other stones on the site 'were re-arranged'.



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, (Figure 20.1).

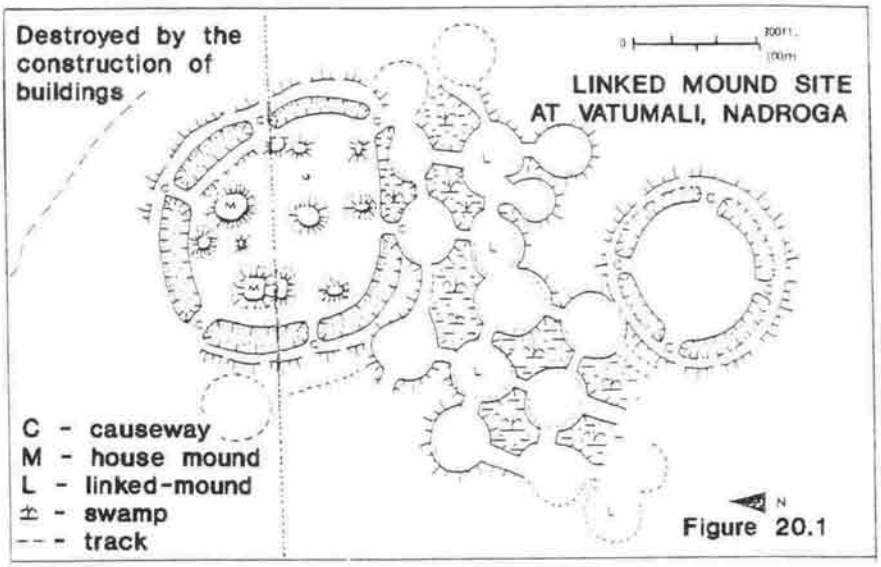


Figure 20.1

20.5.2 Preservation of historic buildings

Recently, considerable interest has been generated in the protection of buildings of Fiji's post-European period and this is being gradually reflected in 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 Gunsite has been restored, as a tourist attraction, by the National Trust of 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.

ENVIRONMENTAL ISSUES - OPPORTUNITIES AND CONSTRAINTS

21 STATE OF THE NATIONAL ENVIRONMENT

21.1 CHARACTERISTICS OF THE ENVIRONMENT

As any perceptive tourist will readily tell you, Fiji is a wonderful country, '"Abundant sunshine, beautiful scenery, a smiling people", all attributes of unspoilt environment. But the comment of a local would more likely be dismissive of this, "That's just a veneer, scratch the surface, and you will see the real Fiji." Both perspectives contain an element of truth, but tourists have the advantage of experiences in differing countries and first impressions are very often significant.

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.
- hydro-electricity and other potential renewable energy sources
- virtual absence of heavy and high-pollution risk industry - virtual absence of poverty 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

Fiji's considerable resources — timber, land and marine products —have in recent years been 'mined' for quick economic return without regard for the future.

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 demographic, economic and industrial pressures from which the majority of serious environmental problems originate in other countries. 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 ecologically complex and highly susceptible to both natural hazards and human violation. This zone will receive the most conspicuous/impacts of global warming.

21.2 ISSUES OF CONCERN

21.2.1 Unsustainable resource use

Fiji is fortunate in having considerable resources, timber, land, marine products and some minerals. But in recent years their exploitation has not been sustainable; in effect they have been 'mined' for 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 (Fig 10.3). 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 to is sugar cane on the marginal foothills. Over the years, many development assistance agencies have encouraged this short-sighted approach through their focus on narrow economic targets. This is now changing but its legacy are Government ministries and departments that indulge in the same blinkered approach. Fiji's resources are not large enough to absorb such treatment indefinitely, yet each year technology advances are available to more young people such that our ability to disrupt and destroy natural ecosystems increasingly outstrips our understanding of these ecosystems and their importance for the nation's future survival.

The ability to allocate, control and manage resource use in the long-term national interest appears to be slipping slowly but resolutely from Government. Private and sectoral interests are prevailing, in the main generated by short term economic considerations. The new Government economic policies and strategies will tend to reinforce this trend.

21.2.2 Pollution and the urban environment

The urban environment

Many of the Fiji's more serious environmental problems, some of which are highly visible, occur in urban areas or in their immediate vicinity. Fiji's population growth rate is moderate, but the 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.

In peri-urban areas agricultural developments which 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 levels are suspected to be dangerously high, but because there is no monitoring in place for the nation to 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 focussed 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.

For this reason, Fiji is clearly at a critical juncture. Unless Government can establish meaningful environmental direction, control and management, there is a real possibility of a rapid and perhaps irreversible deterioration in resource use and an increase in general pollution. Environmental problems tend to be inconspicuous and insidious. Deterioration can continue for many years with little visible change, but when the threshold is reached, deterioration is rapid. It can then be too late to act. As in medicine the preventitive rather than the curative approach is the sensible one.

The gravity of Fiji's environmental problems is not to be measured by their severity or extent, rather by the levity and ineffectiveness with which serious, albeit incipient problems, are being treated. Fiji is too small, too vulnerable, to ignore such problems for any length of time.

21.2. 3 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 global 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 tomake any meaningful commitment to the long-term conservation of Fiji's natural heritage.

Green bans
Fiji cannot afford to be complacent with respect of international 'green' bans which could damage certain exports of national significance, notably native timbers, ginger and sugar. A ban on Pacific island hardwoods has already been proposed by Australian and New Zealand environmental groups because of the perceived exploitation of landowners, poor logging practices and unsustainable nature of the industry. With further lobbying this ban could very easily materialise.

The current unsustainable agricultural practices in the ginger industry could certainly attract a 'green' ban. But of greater significance is 'green' scrutiny of the sugar industry. Pressure could be brought to bear on the EEC by the sophisticated European environmental lobby to reduce or cease the current preferential rates for Fijian sugar, if it could be shown that by so doing the lower yielding sugar farms of marginal cane lands where unsustainable agricultural practices are commonplace, would be forced out of production. This needs very active consideration by Government and the sugar industry because development aid and subsidy schemes are prime targets for the environmental lobby. And the EEC would be in an increasingly untenable position if it had to justify subsidies of any sort which were encouraging unsustainable agriculture, especially in the absence of any obvious attempts at control by the host country.

In comparison, an effective re-introduction of the vetiver grass bunding programme would be a small price to pay.

21.3 COMMUNITY AWARENESS AND PARTICIPATION, THE KEY TO THE FUTURE

"The Fijian term, vanua, has physical, social and cultural dimensions which are inter-related. It does not mean only the land area and the vegetation and animal life... it also includes the social and cultural system." Asesela Ravuvu - The Vanua (from 'Vaki i Taukei', The Fijian Way)

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 fundamental 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 three 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.
- 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 devlopment context.
- an accurate determination of Fiji's natural resources, for without this knowledge there can be no effective planning or education.

The successful approach to conservation and development should 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.

21.4 FUTURE DIRECTIONS - THE ROLE OF THE NATIONAL ENVIRONMENT MANAGEMENT PROJECT

Government's intentions are evident in numerous policy statements and there have been some notable initiatives, but it is currently very far from being 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 ministeries 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 ministeries, 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 resolute and 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.

"A land without people is likened to a person without soul. The people are the souls of the physical environment ... it is a source of life; it provides nourishment, shelter and protection ...and the material basis for belonging."
Asesela Ravuvu

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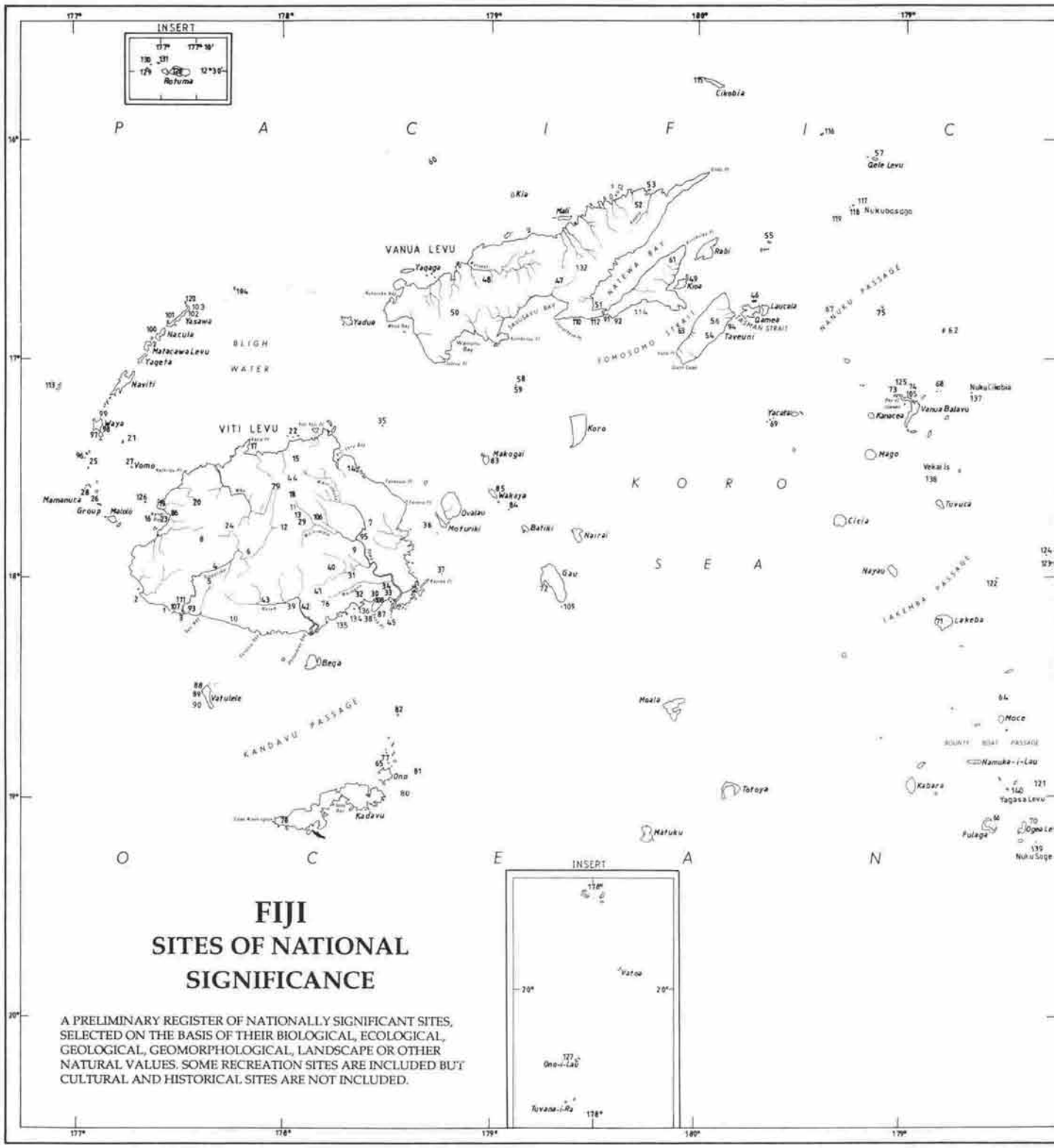
Vegetation	
Kuhl's palm	*Pinanga kuhlii*
Mahogany	*Swietenia macrophylla*
Vetiver grass	*Vetiveria zizanioides*
Seaweed (cultured)	*Kappaphyces alvarezii* var *tambalang*
African tulip tree	*Spathodea campanulata*
Mangrove hybrid	*Rhizophora stylosa* x *samoensis*
Mammals	
Fiji flying fox	*Pteralopex acrodonta*
Mongoose	*Herpestes auropunctatus*
Black rat	*Rattus rattus*
Brown rat	*Rattus norvegicus*
Birds	
Fiji petrel	*Pseudobulweria macgillivrayi*
Silktail	*Lamprolia victoriae*
Kadavu parrot	*Prosopeia tabuensis splendens*
Kula or collared lory	*Phygis solitarius*
Long-legged warbler	*Trichocichla rufa*
Barred-wing rail	*Nesoclopeus poecilopterus*
Pink-billed parrot-finch	*Erythrura kleinschmidti*
Red-throated lorikeet	*Charmosyna amabilis*
Mynah - Common	*Acridotheres tristis*
Mynah - Jungle	*A. fuscus*
Bulbul	*Pycnonotus cafer*
Reptiles and amphibians	
Cane toad	*Bufo marinus*
Fiji burrowing snake	*Ogmodon vitianus*
Insects	
Dalo beetle	*Papuana* spp.
Spiralling whitefly	*Aleurodicus dispersus*
Pine-engraver beetle	*Orthodomicus erosus*
Tip-shoot borer	*Hysylla grandella*
Psyllid hopper	*Heteropsylla cubana*
Fish	
Skipjack tuna	*Katsuwonus pelamis*
Yellowfin tuna	*Thumnus albacares*
Bigeye tuna	*Thunus obesus*
Spanish mackerel	*Scomberomorus commerson*
Trevally	*Caranx* spp.
Emperors	*Lethrinus* spp.
Marbled cod	*Lethrinus* spp.
Chub Indian mackerel	*Rastrelliger brachyscma*
Seaperch	*Lutjanus* spp.
Parrotfish	Scaridae
Bluetail mullet	*Valamugil seheli*
Tilapia	*Oreochromis mossambicus/niloticus*
Grass carp	*Ctenopharygodon idella*
Aquatic invertebrates	
Kai or freshwater mussel	*Batissa violacea*
Clam (cultured)	*Tridacna derasa*

A PRELIMINARY REGISTER OF SITES OF NATIONAL SIGNIFICANCE

The register consists solely of 'natural' sites which includes those of biological, ecological, geological, geomorphological, and landscape interest. It also includes some sites currently used for recreation. Cultural and archaeological sites are not included.
This register is by no means complete.

MAP NUMBER	SITE	DIVISION	SIGNIFICANCE
1	CUVU BEACH	Western	Coastal ecosystem, recreation
2	NATADOLA	Western	Coastal ecosystem, recreation
3	SIGATOKA SAND DUNES	Western	National Park, sand dune ecosystem
4	SAUTABU CAVE	Western	Limestone cave
5	NAQALIMARE LIMESTONE	Western	Limestone ecosystem
6	TATUBA CAVE	Western	Limestone cave system
7	WAILOTUA LIMESTONE	Central	Limestone ecosystem and cave
8	NAUSORI HIGHLANDS	Western	Dry zone mountain rainforest
9	NAQALI	Central	*Neovetchia storckii* palm habitat
10	CORAL COAST REEFS	Western	Marine ecosystem, recreation
11	WAINISAVULEVU FALLS	Western	Waterfall
12	RAIRAIMATUKU PLATEAU	Western	Mountain rainforest
13	MONASAVU	Western	Dam, Hydro catchment protection, rainforest
14	NAKOROTUBU V/THICKET	Western	Unique tropical vine thicket community
15	NAKAUVADRA RANGE	Western	Dry zone rainforest
16	MALAMALA ISLAND	Western	Marine ecosystem
17	VATIA VINE THICKET	Western	Unique tropical vine thicket community
18	WABU CREEK	Western	Intact Fiji dakua montane rainforest
19	DREKETI INLET	Western	Coastal environment, mangrove
20	Mt EVANS RANGE	Western	Intact dry zone montane rainforest
21	WHITE ROCK	Western	Seabird nesting colony
22	MACUATA ISLAND	Western	Crested Iguana habitat
23	NADI BAY REEFS	Western	Reefs, recreation
24	VATURU DAM CATCHMENT	Western	Catchment protection; dry zone rainforest
25	KADOMO ISLAND	Western	Shearwater nesting colony
26	MAMANUCA GROUP	Western	Coastal/marine ecosystem, recreation
27	VOMOSEWA	Western	Flying fox camp; island vegetation
28	MONURIKI ISLAND	Western	Iguana habitat, seabird nesting colony,vegetation
29	MONASAVU SWAMP	Western	Rare montane swamp community
30	SAVURA CREEK	Central	Catchment protection, rainforest
31	SOVI GORGE	Central	River gorge of high scenic value
32	Mt KOROBABA	Central	Rainforest, 5 endemic plant species, recreation
33	NAULU LOKIA SWAMP	Central	White-browed rail habitat
34	NASINU CAVE	Central	Cave system
35	VATU-I-RA	Western	Sea bird nesting colony
36	VATU-I-LAMI	Central	Sea bird nesting colony
37	MUBULAU	Central	Sea bird nesting colony
38	SUVA REEF	Central	Marine habitat and recreational area
39	BATIWAI FOREST	Central	*Gulubia microcarpa* palm habitat; Forest Reserve
40	SOVI BASIN	Central	Rainforest, wilderness area, high scenic value
41	KOROBASABASAGA RANGE	Central	High scenic value
42	LOWER NAVUA GORGE	Central	High scenic value
43	UPPER NAVUA GORGE	Central	Spectacular scenery; geological formation
44	QARANIBULUTI NAT. RES.	Western	Rainforest, Forest Reserve
45	MAKALUVA ISLAND	Central	Sand cay and reef system; recreation
46	MATAGI ISLAND	Northern	Beach forest; flooded volcanic caldera
47	WAISALI	Northern	Dakua rainforest; Amenity Reserve
48	ROKOSALASE	Northern	Buabua Forest (*Fragraea gracipilles*)
49	KIOA ISLAND	Northern	Island environment
50	NASELESELE FALLS	Northern	Waterfall system
51	SALT LAKE	Northern	Unique formation
52	VUNIVIA CATCHMENT	Northern	Lowland dry zone forest
53	VUNIVIA MANGROVES	Northern	Intact mangrove system
54	RAVILEVU NATURE RES.	Northern	Wet rainforest habitat; mongoose free
55	COBIA ISLAND	Northern	Beach forest; geological formation
56	TAVEUNI ISLAND	Northern	Potential World Heritage nomination
57	QELELEVU ATOLL	Northern	Atoll habitat
58	NAMENA BARRIER REEF	Northern	Barrier Reef; marine ecosystem
59	NAMENALALA ISLAND	Northern	Sea bird nesting colony; beach forest
60	GREAT SEA REEF	Northern	Barrier Reef; marine ecosystem
61	TUNULOA FOREST	Northern	Rainforest; Vanua Levu silktail habitat
62	DUFF REEF	Eastern	Turtle nesting site
63	RAINBOW REEF	Northern	Patch Reef/marine ecosystem
64	CAKAULEKALEKA REEF	Eastern	Marine ecosystem
65	YABU ISLAND	Eastern	Seabird nesting colony
66	FULAGA BAY OF ISLANDS	Eastern	Spectacular lagoon; geological formations
67	NANUKU ISLAND	Eastern	Turtle nesting area

MAP NUMBER	SITE	DIVISION	SIGNIFICANCE
68	SOVU ISLAND	Eastern	Seabird nesting colony
69	NUKUTOLU ISLAND	Eastern	Turtle nesting area
70	OGEALEVU	Eastern	Makatea Forest; Ogea flycatcher habitat
71	TUBOU CAVE	Eastern	Island cave system
72	GAU	Eastern	Endangered Fiji Petrel nesting habitat
73	QILAQILA BAY OF ISLANDS	Eastern	Coastal formations/marine ecosystem
74	MASOMO BAY	Eastern	Coastal environment
75	WAILAGILALA ATOLL	Eastern	Atoll, seabird nesting colony; marine ecosystem
76	GARRICK PARK	Central	Rainforest
77	TAQUA ISLAND	Eastern	Seabird nesting colony
78	Mt WASHINGTON	Eastern	Petrel breeding site; unique landscape
79	NADARIVATU NAT. RES	Western	Dakua dominated rainforest
80	GREAT ASTROLABE REEF	Eastern	Marine lagoon ecosystem
81	NORTH ASTROLABE REEF	Eastern	Marine lagoon ecosystem
82	JOSKE'S THUMB	Eastern	Landscape; gealogical feature
83	MAKOGAI IS	Eastern	Beach forest, cycad dominated; coastal/marine ecosystem
84	CAKAU MOMO REEF	Eastern	Marine ecosystem
85	WAKAYA ISLAND	Eastern	Coastal/marine ecosystem
86	SAWENI SANDFLATS	Western	Feeding site for migratory waders
87	SUVA POINT	Eastern	Feeding site for migratory waders
88	GUSUNIQARA PT.	Western	Geological site — marine notch
89	VATULELE CAVE	Western	Limestone cave system
90	RED-PRAWN POOL	Western	Anchialine habitat red prawn pool
91	NASINUNAQERE	Northern	Geological site — marine notch
92	URABUTA PT.	Northern	Anchialine habitat — red prawn pool
93	KOROKUNE	Western	*Veitchia johannis* Palm Forest
94	LAVENA	Northern	Geological site-sea stack
95	WAIDAWARA	Central	Geological site-river process
96	VANUALEVU ISLAND	Western	Geological site-rock type
97	KUCUVE PT	Western	Geological site-rock type
98	MOTOKURO PT.	Western	Geological site-rock type
99	KOROMASOLI PT.	Western	Geological site-rock type
100	DIGIO ISLAND	Western	Geological site-rock type
101	NAMATAYA BAY	Western	Geological site-rock type
102	NAROSALIA ISLAND	Western	Geological site-rock type
103	VATULACA ISLAND	Western	Geological site-rock type
104	YALEWA KALOU	Western	Geological site-rock type
105	VUTUA	Eastern	Geological site-rock type
106	WAINIVUDI R.	Central	Geological site-rock type
107	YADUA QUARRY	Western	Geological site-rock type
108	SEALARK HILL, SUVA	Central	Geological site-rock type
109	YACIWA ISLAND	Eastern	Geological site-rock type
110	SAVASI	Northern	Geological site-rock type
111	MAKASIKO	Western	Geological site-rock type
112	BAKABAKA ISLAND	Northern	Geological site-rock type
113	VIWA ISLAND	Western	Geological site-rock type
114	NANUCA	Northern	Geological site-rock type
115	CIKOBIA ISLAND	Northern	Seabird nesting colony
116	VETAUA	Eastern	Seabird nesting colony
117	NUKUBASAGA	Eastern	Seabird nesting colony
118	NUKUPURETI	Eastern	Seabird nesting colony
119	NUKUSIMANU	Eastern	Seabird nesting colony
120	NANUYAIRA	Western	Seabird nesting colony
121	NAIABO	Eastern	Seabird nesting colony
122	VANUAMASI	Eastern	Seabird nesting colony
123	REID REEF	Eastern	Seabird nesting colony
124	LATEIVITI	Eastern	Seabird nesting colony
125	KIBOBO ISLETS	Eastern	Seabird nesting colony
126	VUNIVADRA ISLAND	Western	Seabird nesting colony
127	YANUYA ISLAND, ONO	Eastern	Habitat of endemic *Leilopisma alazon* skink
128	ROTUMA	Northern	Unique island; geological feature
129	HOFLIUA ISLAND	Northern	Seabird nesting colony
130	HATANA ISLAND	Northern	Seabird nesting colony
131	UEA ISLAND	Northern	Geological features, Beach forest
132	VUNIMOLI NAT. RES.	Northern	Rainforest; Forestry Reserve
133	TOMANIVI NAT. RES.	Western	Rainforest; Forestry Reserve
134	DRAUNIBOTA NAT. RES.	Central	Bay of Islands, Forestry Reserve
135	LABIKO NAT. RES.	Central	Bay of Islands, recreation; Forestry Reserve
136	VUO NAT. RES.	Central	Bay of Islands, recreation; Forestry Reserve
137	NUKU CIKOBIA	Eastern	Turtle nesting areas, seabird nesting area
138	VEKAI ISLAND	Eastern	Seabird nesting area
139	NUKU SOGE	Eastern	Seabird nesting colony and turtle nesting area
140	YAGASA LEVU ISLAND	Eastern	Seabird nesting colony



FIJI
SITES OF NATIONAL SIGNIFICANCE

A PRELIMINARY REGISTER OF NATIONALLY SIGNIFICANT SITES, SELECTED ON THE BASIS OF THEIR BIOLOGICAL, ECOLOGICAL, GEOLOGICAL, GEOMORPHOLOGICAL, LANDSCAPE OR OTHER NATURAL VALUES. SOME RECREATION SITES ARE INCLUDED BUT CULTURAL AND HISTORICAL SITES ARE NOT INCLUDED.