3. Economic performance and natural disasters, 1971–94

During interviews conducted for this study, some initial surprise was expressed about the selection of Fiji for a study of the economic impact of disasters. Fiji, it was argued, had not had a major natural disaster for several years. Furthermore, it was not nearly as vulnerable to natural disasters as some of its Pacific island neighbours. However, preliminary examination of GDP data over the past 25 years suggested that the Fiji economy had, in fact, suffered severe effects of natural disasters, particularly since the early 1980s. A clear picture emerged of substantial fluctuations in both overall GDP and the agricultural and manufacturing sectors which appeared to be partly correlated with the incidence of natural disasters (Figures 3.1, 3.2 and 3.3). This relationship was therefore examined more formally using quantitative statistical techniques (see Appendix 1). The impact of more severe disasters was also explored more qualitatively, as discussed below. A separate exercise was undertaken to explore the longer term impacts of natural disasters (see Box 3.1).

The quantitative statistical analysis confirmed that both the manufacturing and agricultural sectors as well as overall GDP have become increasingly vulnerable to natural disasters since the early 1980s (see Appendix Table 2). Regressions for the later period, 1982–94, excluding sugar in agricultural and manufacturing production indicate that the sugar industry is responsible for the increasing vulnerability of the manufacturing sector but is not entirely responsible for that of the agricultural sector (see Appendix Table 3). Ironically, the economic importance of sugar has also declined since the 1970s, as discussed in further detail in section 4.1. For example, sugar's contribution to GDP as part of manufacturing value added fell from 4.1 to 3.4% between the two periods 1978–80 and 1988–90 whilst its contribution to GDP as part of agricultural value added declined from 10.5 to 8.8%.

Actual relative to forecast economic performance provides a second indication of the economic impacts of disasters. Annual government budget statements are drawn up towards the end of each calendar year and include various growth and other forecasts for the forthcoming 12 months. These constitute short-term forecasts which, by definition, incorporate reasonably accurate assumptions about the prevailing longer-term state of the domestic and world economy and international commodity markets. Unsurprisingly, therefore, these forecasts have proved consistently over-optimistic in years of major disasters.

Figure 3.1: Fiji GDP, 1972-94 (annual growth rates)

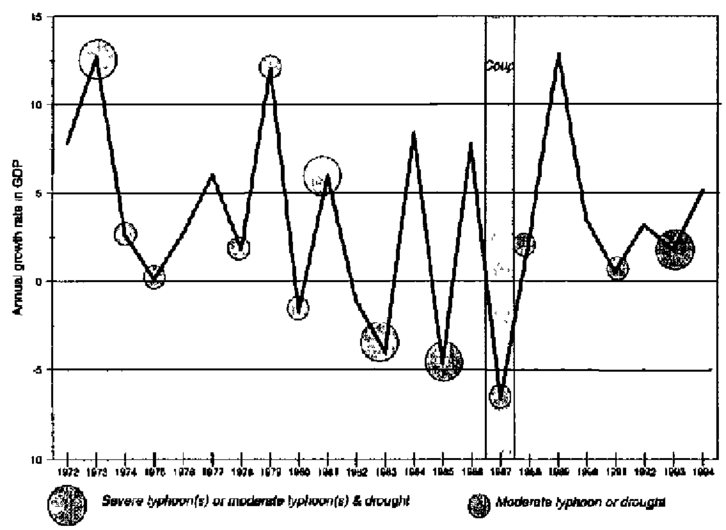
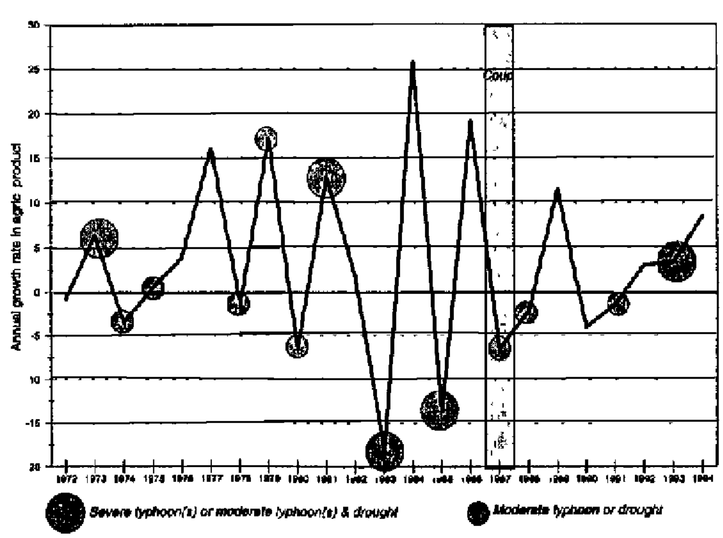


Figure 3.2: Fiji agricultural product, 1972-94 (annual growth rates)



Box 3.1 Modelling the longer-term impacts of natural disasters

To try to capture the impact of natural disasters on longer-term growth, a simple auto-regressive linear model using ordinary least squares multiple regression analysis was developed for the period 1982–93. GDP growth rates (at factor cost) in year t was regressed on GDP growth rates in year t-1 and on the cyclone/drought and coup dummies developed in Appendix 1:

$$y_t = \alpha + \beta y_{t-1} + \gamma C_t + \delta Cp_t + \epsilon_t$$

where y_t is real (constant price) GDP growth in year t, C is the cyclone/drought dummy and Cp is the coup dummy. The regression coefficients were then used to estimate annual rates of growth assuming a no disaster scenario (ie, setting all values of the cyclone/drought dummy to 0).

The results suggest a much smoother rate of growth under the no disaster scenario, as illustrated in Figure 3.4. Although this scenario would imply lower rates of growth in post-disaster years, average growth rates are considerably higher, averaging 4.8% per annum between 1982 and 1994 rather than an actual average annual growth rate of 2.4%.

Obviously, economic development entails far more than the achievement of higher levels of economic growth alone. The growth opportunities foregone as a consequence of natural disasters should not just be taken at face value but translated, for example, into lost investment and employment opportunities and an effective delay in longer term rises in standards of living and reductions in poverty. Moreover, the results exaggerate the projected rates of growth under a no-disaster scenario to the extent that a number of other factors which influence inter-yearly functions in GDP are excluded from the analysis. Nevertheless, it would be reasonable to conclude that average growth rates would be higher if Fiji did not experience intermittent natural disasters

For example, in 1983 – the year of Cyclone Oscar, severe drought and a continuing world recession – the economy declined by 4.0% in real terms compared with a forecast growth rate of 2.7% Prospects for 1985, another year of severe disasters, were not considered particularly bright even before the disasters struck, due to continuing world recession, low international sugar prices and poor investment performance. However, actual performance was even worse than expected as Cyclones Eric and Nigel, as well as faltering recovery in the world economy, resulted

Figure 3.3: Fiji manufacturing product annual growth rates, 1972-94

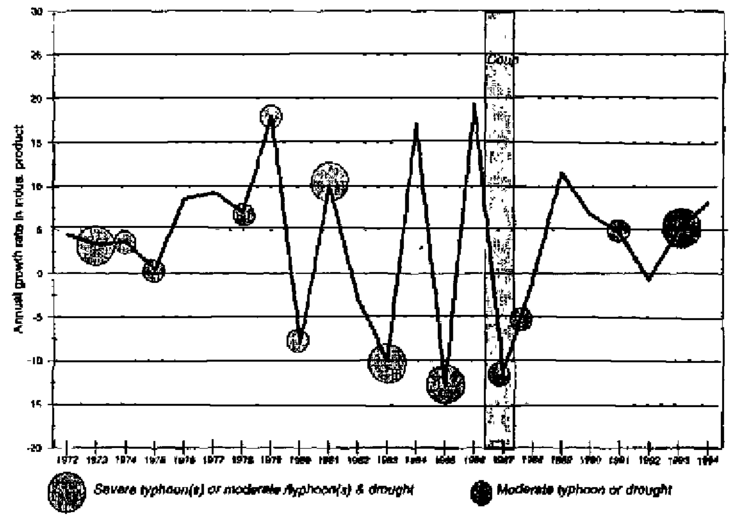
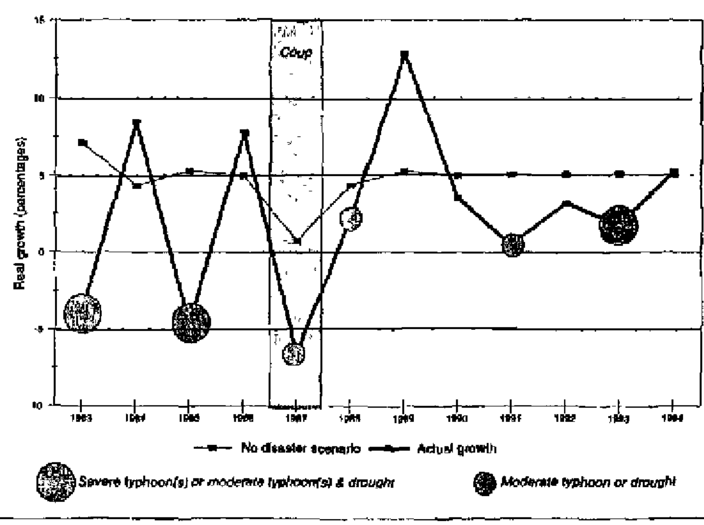


Figure 3.4: Fiji GDP growth, 1983-94: actual and fitted growth assuming a no-disaster scenario



in a real 4.6% decline in nominal GDP year on year compared with a forecast growth rate of 1%. Sugar cane production fell 29% to only 72% of forecast output, with inadequate cultivation and use of fertilisers exacerbating the impact of the cyclones (Fiji Government, 1985b).

The most recent major disaster occurred in 1993 when Cyclone Kina struck (see Box 3.2). This cyclone is widely regarded as one of the most damaging cyclones on record (e.g., Fiji Government, 1993). Again, economic growth was less than forecast, with a real growth rate of 1.8% compared to the 3% forecast. However, despite the severity of the cyclone, this shortfall in performance was relatively minor as compared with the experiences of the early 1980s. The manufacturing sector recovered rapidly and the country benefited from record visitor arrivals as tourism was boosted by strong economic recovery in Fiji's traditional tourist-sourcing markets. Non-sugar agricultural production fell but sugar and forestry output also increased, reflecting a timely start to the season and good milling performance, despite subsequent industrial action in September. [10]

In contrast, in years succeeding major disasters forecasts have typically underestimated actual performance. This appears to reflect a common assumption that sugar production will decline in post-disaster years. For example, weak performance was anticipated for 1984, in part as the sugar industry was expected to continue feeling the impact of the previous year's drought, and in turn placing pressure on the balance of payments. However, in the event, sugar production was 60% higher than forecast, contributing to a real GDP growth rate of 8.4 rather than 4.2%. The balance-of-payments deficit was also considerably reduced. Similarly, in 1986, sugar production increased by 47% year on year due to favourable weather conditions and a concerted effort to motivate farmers. Earlier fears that sugar output would be much reduced as efforts were diverted into the rehabilitation efforts instead, in turn delaying planting, and as a consequence of low prevailing prices proved unfounded. Meanwhile, the economy expanded by 7.7% in real terms rather than by 4.2% as forecast. Forecast growth proved unduly pessimistic, again, in 1994, with an actual growth rate of 5.2% compared with the forecast rate of 3.2%, in part because expected declines in sugar output did not materialise. Instead, Fiji achieved its highest sugar production since 1975, boosted by high sugar content in cane as well as good sugar cane yields. The livestock and fishing sectors also grew strongly

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[10] A similar pattern of poorer actual than forecast performance was observed in 1987 but this probably largely reflected the impact of the coups rather than the severe drought which was experienced the same year. Relatively strong growth of 3.7% was forecast, with an anticipated expansion of sugar exports and of the fishing, forestry, tourism and trade sectors. However, actual GDP declined by a dramatic 6.6% in real terms, largely due to a fall in sugar production and a substantial decline in tourist arrivals, both consequences of the coups.

Box 3.2 **Cyclone Kina, January 1993**

The most recent severe cyclone to strike Fiji, Cyclone Kina, was estimated to cause financial losses to the tune of F$170m (US$110m), making it the country's most costly disaster on record. The heavy costs partly reflected the cyclone's unusual path, resulting in damage in most parts of the country, as well as heavy associated flooding. The northern and eastern parts of Viti Levu and some of the islands in the Lomaiviti Group and southern Lau were declared the most severely hit, whilst 23 people were killed.

The floods destroyed the country's two main bridges at Ba and Sigatoka, causing major disruptions to transport between the Central and Western divisions. A number of landslides, particularly in the interior of Viti Levu, also cut the road access to settlements inland whilst four major jetties were extensively damaged. Some areas suffered almost total crop loss, while farm machinery and equipment was washed away and drainage and irrigation systems damaged. Heavy livestock losses were experienced in Viti Levu, threatening the dairy and meat industries. The poultry industry was also badly damaged. Houses and other infrastructure close to river banks were swept away by floods whilst buildings elsewhere suffered damage from high winds. The industrial production index for the first quarter of 1993 suggested a slight decline in output, in part due to disruptions to the power supply as a consequence of the cyclone. Industrial output for the year overall fell by 4.5% in real terms, despite the fact that factories latterly worked increased overtime to partly make up the lost production. The start of the 1993 school year was deferred for 2 weeks whilst some 294 school buildings were repaired.

As of August 1993, the total relief and rehabilitation programme was estimated at F$64 6m of which 27% was for infrastructure, 28% for economic rehabilitation and 45% for social rehabilitation. External assistance to the value of US$6.3m, including US$89,000 from private sources, was provided in support of the relief and rehabilitation efforts. The government also redeployed F$40.2m of government finance, equivalent to 31 7% of the capital budget (see Chapter 9).

58,000 farmers were assisted through the rehabilitation programme, benefiting from the supply of planting materials, repair of agricultural infrastructure and assistance in land preparation and crop rehabilitation. A fishing rehabilitation programme was also implemented, primarily aimed at the utilisation of marine resources by those affected by the cyclone Rations were distributed to some 140,875 people, equivalent to 17.9% of the population. Meanwhile, reconstruction costs included repairs to the value of F$12.2m to be undertaken by the Public Works Department, (including roads and bridges); F$7.0m for repairs to the electricity network; F$2.7m for postal and telecommunication service repairs; $F5 2m for agricultural sector repairs and rehabilitation; F$12 4m for repairs to Fiji Sugar Corporation facilities; F$1m. for rehabilitation of the pine forests, F$1.2m for repairs to schools; and F$1 2m for health sector rehabilitation.

Source: Rokovada and Vrolijks (1993), Fiji Department of Regional Development (1994).

although production of other crops declined marginally, partly reflecting the lingering effects of Cyclone Kina.

Meanwhile, the fact that the economy achieved a positive growth in 1993 despite Cyclone Kina suggests that the economic impacts of a disaster may be exacerbated during periods of more fundamental underlying weakness, whilst the effects of those occurring during periods of stronger growth, such as Kina, may be overcome more easily. This hypothesis is difficult to prove as it could be argued that forecasts typically underestimate the severity of impact of anticipated factors, such as world recession or depressed commodity markets. Nevertheless, a similar pattern is also apparent in the 1970s. The economy experienced high rates of growth from 1965–73, fuelled by the tourist industry and associated growth in the construction industry. The 1973/4 oil crisis, coinciding with a severe cyclone, Bebe, resulted in temporary difficulties but the economy recovered to experience higher growth again during the remainder of the 1970s, with disasters occurring during this period having little apparent impact on economic performance. In contrast, the early 1980s, when natural disasters appeared to exert a heavy toll on overall growth rates, was a particularly difficult period for the Fijian economy. The country faced increasing debt servicing charges associated with external financing of major infrastructure projects, the consequences of world recession and a deterioration in its terms of trade, in turn reflecting declining commodity prices and soaring oil prices following the second oil price shock of 1979–80. On the domestic front, there was also limited scope for attaining further economic growth from the import-substitution strategy pursued during the 1970s, a strategy which had also resulted in the emergence of a high-cost economy. Despite continuing economic difficulties, the remainder of the 1980s and the early 1990s were fortunately largely disaster-free whilst, as already noted, Cyclone Kina occurred against a backdrop of economic recovery.

This point about the scale of impact of particular disasters relative to underlying economic performance may not be particularly profound. However, it does underscore the need to recognise and address longer-term problems, rather than attribute any difficulties to natural disasters, an easy scapegoat. It also highlights the fact that some of the most economically-vulnerable elements of Fiji's economy, in terms of their dependence on external markets, are also vulnerable to natural disasters. Diversification out of more disaster-prone sub-sectors would help minimise inter-annual fluctuations in economic performance, which can only serve to undermine investors' confidence.

4. Productive sectors and natural disasters

4.1 Agriculture

Performance in the agricultural sector continues to remain critical to the overall economy. The sector accounts for some 20% of GDP and 56% of export earnings while more than 75% of households are engaged either full or part-time in crop production, livestock, forestry and fisheries (World Bank, 1995). Furthermore, subsistence farming for on-farm use and consumption by relatives in urban areas, much of which probably goes unrecorded in official statistics, remains an important source of food supply and even sugar cane farmers grow a major part of their own food supplies. Subsistence farming consists of production of a mixture of rootcrop staples, tree crops, green vegetables and a range of other crops as well as livestock farming (Porter, 1994). Agricultural productivity is relatively low, in part reflecting limited use of fertiliser and other agro-chemicals, except in sugar production (World Bank, 1995).

According to the 1991 National Agricultural Census, farms average 7.2 ha in size (Fiji Ministry of Primary Industries and Co-operatives, 1992). However, land distribution is relatively unequal and over 60% of farms are under 3 ha. Flat, undulating and gently hilly land account for only 31% of the total land area, with most land suitable for intensive agricultural production located in coastal areas, river deltas and the wider alluvial terraces of the lower courses of many rivers (Porter, 1994). Yet these areas are also particularly susceptible to cyclones, coastal and riverine flooding, storm surges and tsunamis. Most first class arable land is already in use and additional increases in land under cultivation now imply expansion into marginal hill areas and steep lands, causing environmental degradation and increasing the risk of natural hazards. Certain agricultural practices in these areas, such as steep land sugar cane and ginger production, have contributed to soil erosion, loss of topsoil and sedimentation of rivers and streams, the latter effectively exacerbating problems of flooding.

The agricultural sector is particularly susceptible to droughts and cyclones although the extent and nature of impact depends partly on the timing of each disaster relative to the cropping cycle of various crops. Total rainfall is generally considered sufficient for rainfed production except in the Western Division but occasional prolonged dry periods of 3-4 months can create difficulties elsewhere (Amerasinghe, 1984). Droughts reduce yields of most crops, with the notable exception of sugar which to some extent performs better under poor rainfall conditions (see below). Drier conditions are also associated with pest outbreaks, with further adverse implications for crop yields. More generally, droughts can have particularly severe effects on reduced yields if they are preceded by several years of low rainfall; or if they succeed a cyclone which has already damaged crops. They can also delay planting operations.

The impact of cyclones on crop production is complex. Amerasinghe (1984) identifies the following effects:

> '. . . lack of sunlight due to cloudy spells, lack of soil air due to excess rainfall or inundation as a result of storm surges, lack of soil nutrients and anchorage due to erosion and landslides, physical injury due to strong winds, floods, storm surges or sea spray.[11] Elevated humidity and splashing by rain or carriage of spores by wind and ecological changes may also increase the incidence and severity of certain pests and diseases Rapid weed regrowth also has been associated with the season.' (p.131).

Trees can be particularly vulnerable as cyclones break branches, defoliate trees and sometimes even uproot them. Production from remaining trees can be reduced for several years as, for example, in the case of coconuts or breadfruit. Cyclones can also dislodge other crops, such as sugar cane, damaging rooting systems and greatly reducing production. Heavy rainfall, which is often associated with cyclones, can also result in the waterlogging of soils and the consequent rotting of crops It may also wash out more shallow-rooted crops (Porter, 1994). In fact, cyclones have completely destroyed food crops in some parts of Fiji on occasion. A rapid succession of cyclones, or cyclones and droughts, also gradually increases the vulnerability of perennial crops as, for example, observed in the case of coconut stands in 1983.

Disasters, particularly cyclones, can also have indirect impacts on the agricultural sector via their impact on farming equipment and agricultural infrastructure, such as drainage and irrigation systems. Transport and marketing infrastructure may also be affected, both in terms of physical damage and of capacity relative to demand, as the movement of relief supplies places additional pressures on the system. For example, the 1992 drought coincided with the sugar harvest, reportedly making it difficult to obtain trucks to move water because truck owners could make more money transporting sugar cane.

However, Chung (1987: 43) points out that the impact of natural disasters may not be entirely negative· they offer 'an opportunity to stimulate greater activities through (1) increasing areas of both cash and food crops, (2) replacing lesser economic

[11] For example, salt-water sea-spray created as a consequence of Cyclone Joni (December 1992) caused damage to rootcrops all over the island of Kadavu (Fiji Department of Regional Development, 1993).

crops,[12] (3) introducing high yielding as well as less vulnerable crops, and (4) improvement of existing infrastructure and support systems'.

There are also a variety of ways in which the agricultural impacts of natural disasters can be mitigated, both at the household level, with the objective of ensuring household food security, and in terms of national agricultural output. Vulnerability to disasters can also be reduced by adjusting farming techniques, cropping patterns and the varieties of crops produced. For example, multi-cropping or multi-tiering may offer a way of protecting crops against high winds. Meanwhile, cultivation of a number of crops with varying seasonality and dates of maturity can also offer some protection. Traditional agricultural practices recognised the vulnerability of households to natural disasters, with the cultivation of a wide range of crops with varying vulnerability to high winds and water requirements (Rokovada, no date). For example, swamp dalo (taro or *colocasia esculenta*), also known as *via*, was grown in flood-prone areas. Although the crop takes 3 years to mature, it can withstand floods and hurricanes and be stored for up to 15 months without deteriorating. Other crops were also preserved and stored for use in periods of hardship. For example, yams were commonly grown before the cyclone season and stored whilst another variety of dalo, *dalo-ni-tana*, could be stored underground for months. A number of foods were also fermented, particularly plantain, breadfruit, Tahitian chestnut, dalo and cassava. After several months' fermentation, the food would keep indefinitely and could be served baked, boiled or steamed.

However, regression analysis of the impact of cyclones and droughts on agricultural GDP suggests increasing vulnerability of the sector to disasters, as already noted. This is partly due to an apparent increase in the vulnerability of sugar but also, as discussed below, of other crops such as coconuts. More generally, traditional disaster mitigation practices have gradually been eroded. For example, nowadays, with the widespread availability of cold-storage facilities, traditional long-term storage practices are not very common. Cultivation of disaster-resistant crops also occurs on a much smaller scale than in the past.

Moreover, current changes in the agricultural sector suggest that the sector's hazard vulnerability could increase even further in the medium term. Since the 1980s, efforts to promote diversification have been stepped up and movement into irrigated rice, vegetables, fruit and, more recently, flowers and herbs has begun. New crops include citrus, pineapple, paw-paw, mango, and certain indigenous crops such as taro, duruka (*saccharum edule*) and yaqona (*piper methysticum*). Dairy, beef and poultry production has also increased. Yet many of the new crops are highly vulnerable to cyclones and droughts. Moreover, much of the diversification is aimed at the export

[12] By 'lesser economic crops' Chung refers to crops which are of less importance to the economy than certain other crops.

market yet even wind-damaged crops with only slight surface markings may not be acceptable for export. Meanwhile, individual farmers are increasingly producing just a few crops rather than a larger number, with varying vulnerability to a range of weather conditions and natural hazards. Environmental degradation is also playing some role in increasing the disaster vulnerability of the agricultural sector and could become a critically important factor in future years. Natural coastal vegetation, which provides some protection of crops against sea spray, has been partly destroyed. There has also been some reclamation of mangroves, as already noted, whilst an estimated 11–16% of the country's forests have been converted to non-forest uses since the mid-1960s (IUCN, 1993). The country's *National Environment Strategy* concluded that 'Fiji is definitely at a threshold, environmental problems ... have the potential to escalate rapidly both in extent and severity' (ibid: 13).

However, increasing vulnerability is not inevitable. For example, there is some scope for diversification into crops which are less hazard vulnerable, such as winter crops which are grown under irrigated conditions and also, by definition, outside the cyclone season. For example, although Cyclone Sina (November 1990) caused some damage to vegetables and squash, the extent of damage was limited by the fact that much of the crops had already been harvested (National EMSEC Task Force, 1990). Early maturing perennial winter crops could offer particular benefits in terms of their reduced hazard vulnerability. Diversification back into traditional rootcrops and tubers could also play an important role, both at the household and, with increasing development of niche export markets, the macroeconomic level. For example, export markets have already been established for less disaster-vulnerable crops such as dalo, duruka and yaqona (Fiji Government, 1993). As already indicated, faming techniques and choice of crop varieties can also be particularly important in reducing the impact of natural hazards.

Despite such possibilities, the Government appears to have done relatively little to promote measures to reduce the agricultural sector's vulnerability to natural disasters. According to the *Fiji National Disaster Management Plan*, communities and individuals are expected 'to take adequate preparations before disasters to ensure the availability of food after the disaster, and to recover, to the extent possible, damaged food crops for consumption' (NDMC, 1995: V-6). Moreover, the Plan specifically identifies a role for the Ministry of Agriculture in reducing the vulnerability of agriculture to natural disasters. This would seem to imply a part for the government in providing advice on strategies to reduce the impact of disasters and in helping to sustain knowledge and practice of traditional coping methods. However, it is not clear to what extent the government is fulfilling these roles nor how much formal research has been undertaken into disaster mitigation strategies. Broader policy documents also appear to fail to recognise, let alone address, the potentially serious agricultural impacts of natural disasters. For example, the *Opportunities for Growth* document (Fiji Government, 1993) makes no mention of natural disasters in discussing constraints faced by the agricultural sector, whilst the policies and strategies outlined also fail to include any aimed at reducing the sector's disaster vulnerability

More positively, the government does support agricultural rehabilitation efforts in the aftermath of a disaster, which are important in ensuring a relatively speedy recovery and restoring household self-sufficiency. There is typically increased planting of more disaster resistant crops in the aftermath of a disaster, a practice endorsed by the government. For example, several district officers promoted a shift to more drought resistant crops, such as yams and kawai in response to the 1992 drought. The Ministry of Agriculture also recommends the planting of sweet potatoes and other quick maturing crops, with short growing seasons of only 2–4 months; and helps ensure availability of both sweet potato cuttings and dalo tops for planting in support of such efforts.[13]

A statistical analysis of the impact of cyclones and droughts on five major food, agro–industrial and export crops – sugar, coconut and copra production, roots and tubers, cassava and ginger – was undertaken as part of this study with the objectives of:

- to establish the relationship between rainfall variability and cyclones and crop yields and acreage planted (as disasters may effect cropping decisions or hinder planting operations)[14]; and
- to identify which crops, and thus which parts of the economy linked to these crops, are more sensitive to natural disasters (see Appendix 2).

The results of this analysis are presented below, together with a more qualitative discussion of the nature and extent of vulnerability of individual crops.

Coconuts Coconuts are the country's second largest traditional export crop and form the economic basis of the Eastern Islands and much of the Northern Division (Fiji Ministry of Primary Industries and Co-operatives, 1992). Some 48,000 people are estimated to rely on coconut production as a source of income (World Bank, 1995), with the crop grown under a mixture of large- and small-scale production. Copra is crushed and converted into oil, primarily for export.[15] Coconuts are also used for on-farm consumption, with most meals in the coconut-growing regions involving the use of coconut milk (Brookfield et al., 1985). According to the 1991 agricultural census,

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[13] In practice, some dalo tops are eaten rather than planted to meet immediate food needs.

[14] For example, Cyclone Kina (1993) and subsequent adverse weather conditions delayed the preparation of land for maize production, leading to a 4.5% decrease in the acreage planted (Fiji Ministry of Agriculture, 1994).

[15] Approximately 6,000 nuts are required to produce one tonne of oil

over half of the area under coconuts was mixed with pastures or other crops (Fiji Ministry of Primary Industries and Co-operatives, 1992), effectively making it difficult to assess the scale of damage in the aftermath of a disaster.

Since the early 1990s there have been growing concerns about the advanced age of the country's coconut trees and, thus, about the future viability of the industry. Some two-thirds of the trees are now senile and, reflecting this, production has gradually declined although the acreage under coconuts is reported to have remained approximately constant over the past 15 years (World Bank, 1995). Poor price expectations since the 1950s have acted as a continuous disincentive to replanting while intermittent damage from cyclones has added a further disincentive (Brookfield et al., 1985).

Cyclones can cause widespread premature nutfall and delayed setting of new nuts. Older trees can take 3–5 years to recover whilst younger ones do not bear nuts for up to 7 years and can also be knocked down. For example, copra production fell by 35% in 1993 due to the combined impacts of Cyclone Kina, depressed world market prices and higher sale of whole nuts (Fiji Government, 1994c). Even lower production was reported in 1994, reflecting the continued effects of Cyclone Kina as well as the increasing senility of the stands. Coconut trees are generally less susceptible to rainfall shortages but severe droughts can result in substantial declines in production, particularly when they occur in the aftermath of a cyclone, and recovery is slow. For example, the prolonged 1987 drought was largely responsible for a 34% decline in coconut production and a 43% fall in copra production, with a further 15% decline in the latter in 1988, whilst production of both coconuts and copra was not restored to 1986 levels until 1990.

Regression analysis undertaken for this study on both coconut and copra production confirms their high vulnerability to cyclones. It also indicates increasing vulnerability between 1970–82 and 1982–92, probably reflecting the increasing age of trees. The regression analysis provides little evidence of any correlation with rainfall but this could reflect the more extended impacts of rainfall deficits, with the effects felt over a number of years rather than in the drought year alone.

Despite their vulnerability to natural hazards, coconuts will continue to represent an important source of income for certain rural areas, particularly in the outer islands where there are few alternative income-generating opportunities. New high-yielding dwarf hybrids are currently on trial in a relatively drought and cyclone free area of the country, achieving yields of 3–4 tonnes per annum compared with 1.5–2 tonnes from older varieties. These new varieties will gradually be planted up in certain parts of the country.[16] However, hybrids are more susceptible to droughts, with water shortages affecting fruiting, and will therefore only be planted in areas with sufficient rainfall. They also have shorter rooting systems and so will be planted in 'less cyclone prone areas', according to a Ministry of Agriculture spokesperson.[17] Thus, natural hazard risks will effectively limit the scale of potential productivity gains by limiting the adoption of higher-yielding varieties

Rice Rice is largely produced under rainfed conditions as a subsistence crop, with production concentrated in the Northern and Central Divisions. Rainfed production accounts for some 90% of total paddy production. Rice is normally planted in mid-November but can be delayed up to mid-December if there is insufficient water available. If water shortages continue through mid-December no rice can be planted that season. Rice production can also be adversely affected by cyclones, primarily as the heavy rainfall which cyclones are often associated with dislodges plants.

Regressions of rice yield against cyclone and lagged cyclone dummies suggest that in practice national rice production has been relatively immune to cyclones although individual farmers have suffered damage. However, rice yields are sensitive to rainfall fluctuations, with some evidence of increasing vulnerability as rice production has expanded marginally. This relationship is confirmed by data for individual years For example, the 1983 drought resulted in a 14.8% fall in rice yields year on year whilst yields fell by 9.5% in 1987. However, no relationship was found between acreage and rainfall lagged one year, implying that rainfall deficits do not result in a diversion out of rice production.

Rootcrops Rootcrops are grown both for on-farm consumption and as a source of cash income, providing an important source of revenue for some subsistence farmers. Cassava is the most common traditional staple in Fiji and is mainly grown by smallholders, largely as "pure stand". It is planted throughout the year and takes 9–12 months to reach maturity. Dalo is another common rootcrop, grown for both domestic consumption and, particularly in recent years, export. The main planting season is between September and November, with an off-season crop planted between March and June. However, dalo can be planted throughout the year in the wet zone. The crop takes 8–12 months to reach maturity.

On balance, rootcrops are relatively immune to natural disasters. Cyclones agitate the leaves and stems of cassava, causing the underground roots and tubers to move and,

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[16] For example, the 1993 Annual Report of the Extension Department of the Ministry of Agriculture outlined plans to establish 128 0.5 ha coconut hybrid farms and to replace senile and damaged coconut stands with Fiji Tall and Rotuma Tall varieties.

[17] It is not quite clear what is meant by 'less cyclone prone areas' since all areas of Fiji are regarded as equally vulnerable to disasters.

in turn, resulting in damage and bruising and, thus, quick infection and rotting. More mature crops are particularly susceptible to such damage but younger ones may recover. However, losses can be mitigated by cutting the leaves and stems down to almost ground level immediately prior to a cyclone, as is commonly done although this reduces the flavour of the crop. Yams and dalo are generally less vulnerable to the wind effects of cyclones. However, all rootcrops can be destroyed by flooding, which is often associated with cyclones. Damaged crops which are not harvested within 2 weeks of a flood are lost. Droughts present less of a problem as neither cassava nor dalo have major water requirements.

The relative immunity of rootcrops to both cyclones and droughts is confirmed by regression analysis,[18] underlining the importance of promoting increased production of these crops both to meet domestic food requirements and to help stabilise export earnings during the aftermath of major natural disasters. Exports of rootcrops have already begun, as already noted. For example, yams are largely produced for the export market nowadays rather than for storage for use in the aftermath of natural disasters whilst cassava and dalo are also being exported. Export earnings from rootcrops increased by 88% in real terms between 1988 and 1992, to F$3.2m.

Ginger Ginger was introduced to Fiji as a diversification crop and the government has identified it on several occasions as one of the 'most successful' diversifications crop to date because of its high labour absorption capacity and significant contribution to value added output (e.g., Fiji Government, 1992: 14) The government supports further diversification into ginger production. However, certain reservations about ginger production have gradually crept into official documents, with warnings of the need to encourage production in an environmentally sustainable way because of the potential damage it can cause (e g., Fiji Government, 1995). To date, production has remained limited and has not created substantial environmental damage but current practices are considered to have set a poor precedent for further expansion (IUCN, 1993) [19]

Ginger is an annual crop which is planted in September and harvested either in late February or March, as immature ginger for processing into syruped and crystallised forms, or in September, as mature ginger which is dried and ground to a powder. The crop requires high rainfall and good drainage for successful cultivation and so is often grown on hillsides (Porter, 1994), effectively making it vulnerable to drought. Ginger

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[18] Long series of production, yield and acreage data are not readily available for individual rootcrops. Data on rootcrop acreage published by the FAO, is rounded up to the nearest thousand hectares effectively making it insensitive to analysis because acreage is relatively low in the first place (for example, averaging 5,000 ha in 1989–92).

[19] There has also been a major problem of disease in the ginger crop

production can also be adversely affected by defoliation during cyclones, reducing yields although not directly damaging the ginger

Regression analysis suggests no significant relationship between rainfall variability or cyclones and ginger production at the national level. However, incomplete data on yields of immature ginger alone suggest otherwise, with an apparently significant decline in yield in years of major cyclones This is confirmed by reports of the impact of Cyclone Kina which resulted in a 34 6% decline in ginger production in 1993 and a consequent fall in exports.

Sugar Sugar is the single most important crop in Fiji, as already indicated. It contributed 41% of agricultural GDP, 28% of manufacturing GDP and 39% of merchandise exports in 1992–4. Molasses, a by-product, is sold by tender to the highest bidder and normally secures good returns. Some 20,000 people work on cane farms, including landless cane cutters who earn very low wages.[20] Farming is based around small-holder production, with average holdings of 3.8 ha (Fiji Ministry of Primary Industries and Co-operatives, 1992).

Production is undertaken under rainfed conditions. Sugar cane can be replanted every year but farmers tend to adopt multi-ratooning, with an average of 5, and in some cases up to 7, crops derived from shoots which spring up from existing sugar cane roots following each harvest. The older the ratoon, the weaker and shorter the crop. Multi-ratooning therefore reduces sugar yields but, since payments are based on cane bulk rather than sugar content, there is little incentive to adjust practices. Planting of new cane occurs in around March and sugar grows for 12–16 months before it is cut. The harvest and milling season runs from April through December.

The sugar industry is managed by the Fiji Sugar Corporation (FSC), a state enterprise which provides extension, research, transport, milling and marketing services. The FSC operates four sugar mills, three of which produce raw sugar for export and one for the local and regional market. The FSC also operates a railway network, including rail-lines and locomotives, to transport cane to the mills.

Production expanded during the 1970s as the acreage under sugar cane increased. It was envisaged that output would continue to grow in the 1980s and the Eighth Five-Year Development Plan set an output target of 600,000t by 1985. However, actual production was only slightly over half this level in 1985 and around two-thirds of it in 1986. The Ninth Five-Year Plan adopted the same target but, instead, sugar production remained approximately static during the remainder of the 1980s, reflecting little change in either area planted or yield. This poor performance was

[20] In the early 1980s, many landless cane cutters were reported to be permanently in debt (Barr, 1990).

principally due to a combination of natural disasters and the limited incentive to increase yields.

Cyclones can damage sugar cane, dislodging crops and causing cane to break but generally not uprooting plants. For example, Cyclone Oscar devastated the main sugar-growing areas in the Western Division, resulting in a US$20m loss of earnings for cane farmers whilst the 1985 cyclones resulted in losses of US$21.7m. However, crops will normally recover the following season. Meanwhile, various infrastructure including mills and tramlines have been damaged by cyclones on a number of occasions, although mills are cyclone-proofed, whilst sugar stocks have been lost.[21] [22] In terms of disruption to milling operations, cyclones occurring at the beginning of the cyclone season, between October and December, are potentially most serious because they coincide with the harvest and milling season. For example, although Cyclone Kina caused extensive damage, estimated at some F$15m, to two mills as well as tramlines and bridges (Rokovada and Vrolijks, 1993), it occurred at the beginning of the maintenance period. Thus, repairs were almost fully completed before the beginning of the 1993 milling season.

Droughts have also been identified as a major problem for the sugar industry (Amerasinghe, 1984). However, the relationship between sugar production and rainfall variability is complex. Large and timely inputs of water, as well as temperatures of around 30^{0}C, are required during the earlier stages of growth, whilst dry, cooler conditions are needed in the months immediately prior to harvesting to ensure high sugar content. Indeed, in the early 1960s, sugar production was deliberately moved from the wet, eastern side of Fiji to the climatically more suitable dry regions of the southwest and northwest coast of Viti Levu and to parts of Vanua Levu. Moreover, less severe droughts can result in improved sugar content of cane as, for example, in 1987. However, rainfall in the dry season is uneven and conditions are often too dry for sugar production, reducing yields. For example, large parts of the sugar crop had to be replanted following the severe 1983 drought. The FSC is currently working on the development of more drought resistant strains although it has not explored the possibility of improved cyclone resistant varieties. Studies undertaken to consider the viability of irrigating the sugar crop have concluded that this would not be a viable option.

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[21] For example, some 20,000 tonnes of raw sugar was washed away after the roof of a store was blown off during Cyclone Eric or Nigel in 1985 (*Islands Business*, 1985).

[22] The FSC operates its own bio-gas generators, exploiting a by-product of sugar production. This implies that milling operations are not vulnerable to potential power shortages in the aftermath of a cyclone or during an extended drought.

Meanwhile, the disaster vulnerability of the sugar crop has increased over time due to its gradual expansion into hilly areas and marginal coastal areas, in turn resulting in soil erosion. Between the mid-1970s and mid-1980s, acreage rose from 45,000 to over 70,000 ha, encouraged by artificially high prices although yields in the newer areas have been much lower. Indeed, the *National Environment Strategy* identified the FSC as by far the most significant agent of land degradation in Fiji today 'because of its encouragement of sugar cane cultivation in marginal hill lands without limiting production to gentler slopes' (IUCN, 1993). Formal analysis of the relationship between sugar cane yields and natural disasters confirms a much stronger correlation between sugar cane yields, cyclones and drought in the period 1982–94 than in 1970–82. Meanwhile, over-expansion into lower-yielding marginal lands together with a failure to modernise the industry has transformed the Fiji sugar sector from a low- to high-cost producer since the early 1980s. However, because of preferential pricing arrangements, Fiji has not been under pressure to increase its international competitiveness.

Concluding comments Carter et al. (1991: 278) identify three factors which should determine the types of mitigation adopted and the level of resources invested in their development:

- the importance of activities to the economy;
- the vulnerability of enterprises to likely natural phenomena;
- the cost of effective protection.

According to the first of these criteria, particular emphasis should be placed on mitigating the impact of disasters on the Fijian sugar industry, with sugar production perhaps even scaled down. However, the industry's importance has been distorted by preferential access and pricing arrangements with the European Union (EU) and, to a lesser extent, the USA which have ensured artificially high sugar prices and, thus, encouraged domestic production. For example, in mid-1992, the two markets offered prices some three times those prevailing on the open market (IUCN, 1993). This favourable price environment is expected to be partially eroded up to the year 2001 as agricultural support and protection is gradually reduced in accordance with the Uruguay General Agreement on Tariffs and Trade (GATT) Agreement EU sugar prices may decline by an estimate 1–3% per annum between 1995 and 2000 (FSC, 1994), finally resulting in some diversification out of sugar production and a potential simultaneous reduction in the vulnerability of the agricultural sector to natural disasters.[23]

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[23] The Fiji government suggested in its 1992 Budget Statement (and reiterated in its 1993 and 1994 Budget Statements) that a dual pricing system should perhaps be considered, with farmers allocated a quota of high price cane for exports to the EU under the Lomé Convention and then left to face lower world market prices for sugar exported to other destinations rather than being

This would therefore seem a particularly appropriate moment to develop a strategy aimed at reducing the agricultural sector's vulnerability to natural disasters. The government has apparently been investigating alternative crops (Fiji Government, 1994a and 1994c) and, if it is not already, reduced disaster vulnerability should be one of the main goals of any alternative production strategies

Two of the most successful diversification crops to date which are yaqona and dalo, both of which are less perishable than competing high-value crops, are already fairly widely grown in Fiji and, moreover, are relatively immune to natural disasters. There has already been some success with the export of these crops but they do not receive priority attention from the Ministry of Agriculture and their production could be promoted more (World Bank, 1995). Production of off-season export crops such as vegetables also offers some scope for reducing disaster vulnerability to the extent that the growing season occurs outside the cyclone season. However, they would require irrigation, with implications for water resources (see below) as well as air freight capacity.[24]

4.2 *Forestry*

Fiji has some 935,000 ha of forest, covering 51% of the country (Porter, 1994). Much of this forest cover is indigenous but several forest plantations have been established. In terms of production forests suitable for commercial timber production, there are some 270,000 ha of indigenous forest and 145,000 ha of plantation forest comprised of 57,000 ha of softwoods (primarily pine), 48,000 ha of hardwoods and 40,000 ha of coconuts.

Since the mid-1980s, the timber industry has been expected to shortly emerge as one of the country's major growth sectors, as it moves from the development to processing and export phase. The government has placed particularly high hopes on

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paid an average of the higher and lower prices for all production, as is currently done (Fiji Government, 1991, 1992 and 1994a). This, it was argued, would allow farmers to make more rational production decisions and increase efficiency of production Although no mention was made of the implications in terms of increased or reduced vulnerability to natural disasters, it could also achieve this

[24] For example, one possible winter crop which could be grown is squash. Market research in Fiji identified a seasonal market niche for squash exports to Japan over ten years ago, in 1982/3. However, Fiji failed to take this opportunity up because of the high average returns offered to farmers by sugar production although Tonga later exploited the opportunity instead with considerable success (ADB, 1995). Squash production for export has now begun in Fiji on a limited scale and the sector is expected to expand.

pine exports which are eventually expected to compete with sugar as the country's primary export. In 1990, some sources estimated exports in excess of F$100m by the end of the century whilst increased furniture production for both the domestic and export markets was also anticipated. (Fiji Government, 1990). However, the timber industry is vulnerable to disasters and, largely because of this, there has, in fact, been little real growth in timber earnings since 1988. Timber exports accounted for only 5.5% of domestic exports between 1991 and 1994, averaging F$33.4m (in 1994 prices), whilst sugar exports contributed 39.1% of the total. This section considers the impact of natural disasters on one sub-sector of the forestry, the pine industry.

Fiji Pine Large-scale pine plantations were initially established in Fiji under the Ministry of Agriculture, Fisheries and Food following experimental planting of a range of species of trees in various agro-ecological areas of the country. In the drier zones, pine was found to be the most durable species growing all year round. The pine plantations were initially used as part of a watershed management scheme, to prevent erosion of soils upon which little else could be cultivated. However, subsequent tests revealed that the chip was of a very high quality and could be used for pulp, paper and sawn timber production. The decision was therefore taken to extend production. In 1976 ownership of the pine plantations was transferred to the Fiji Pine Commission with the primary objective of establishing a viable forestry industry based on planted forests (Fiji Government, 1976). In 1991 Fiji Pine was corporatised into a public limited company as part of a wider privatisation programme of government bodies. Pine forests are now largely concentrated in west Viti Levu and the provinces of Bua and Macuata in Vanua Levu.

However, Fiji Pine has consistently under-performed in meeting both plantation and timber production targets. In 1976, there were 19,708 ha of planted forests under the Pine Scheme. The Eighth Development Plan (1981–85) aimed to expand the plantation to 54,000 ha in Viti Levu and 6,800 ha in Vanua Levu but, in fact, fell 31% short of its target. The Ninth Development Plan (1986–90) was less ambitious, setting a target figure of 55,500 ha by 1990 but, instead, total area planted gradually declined over the duration of the Plan to only 33,671 ha In terms of log and timber production, performance has also been poor. Harvesting began in 1983 with the timber initially milled at a single small plant. Production of pine logs and saw log timber was expected to expand rapidly in the mid-1980s as pine trees reached maturity (Fiji Government, 1984). In 1985, site works therefore began on a larger mill which came on-stream in 1987. This mill was expected to begin operating 24 hours/day immediately; and to provide some 403 direct jobs in logging, transport and mill operations, with a further 430 jobs generated indirectly through multiplier linkages with other sectors. However, in 1996 the mill was still operating only 12 hours/day due to lower throughput of wood than originally anticipated. It is now envisaged that the mill should be working at full capacity by 2005, assuming no further setbacks in production.

Damage inflicted by cyclones and fires lies at the crux of Fiji Pine's failure to date to achieve its objectives. For example, by the end of 1990, certain areas in the southern forests had been replanted twice without being harvested because of cyclones and fires. Trees up to the age of around 7 years are relatively supple and so tend to lean and bend during cyclones, rather than break or topple over Nevertheless, trees over a height of about 2 metres subsequently need to be propped up whilst younger ones require supportive sticks, a time-consuming and costly process. Older trees tend to snap during cyclones, effectively destroying the trees. Although the broken wood can be milled, it will rot if it is not collected within about 6 months and will typically be of lower quality. The amount of wood harvested may also be substantially reduced,[25] whilst dead and severely damaged trees are also more susceptible to destructive insect activity. Successive cyclones have also inflicted periodic damage on seed collection areas and disrupted planting operations while staff dwellings and industrial buildings may be damaged. Despite pine's relative immunity to drought conditions, the pine plantations have also suffered severe damage from increased risk of fire during periods of drought.

For example, Cyclone Oscar, which occurred in March 1983 in the middle of the pine planting season, severely disrupted planting operations, causing a 24% or 800 ha shortfall in the planting target as seedlings were diverted to restock areas damaged by the cyclone. Planting was further adversely affected by the subsequent drought, which both shortened the planting season and killed some newly-planted trees, necessitating replanting. The diversion of labour from planting into the propping and uprighting of trees also disrupted planting operations. The replacement of forests damaged by Cyclone Oscar accounted for almost two-thirds of the total 5,132 ha planted in 1984 Uninsured losses as a consequence of the cyclone were estimated at some F$2.1m net of insurance recoveries while Fiji Pine received over F$2m in insurance claims.

In 1985, further damage was inflicted by Cyclones Eric and Nigel, particularly to the Lololo forest in north-west Viti Levu. In 1990 4,866 ha of pine forest, valued at F$6.4m, were again lost due to cyclone damage while a further 3,493 ha, valued at F$5.3m, were written off due to poor stocking as a consequence of earlier fires and cyclones. Some 1,827 ha, or 1.03m trees, had to be uprighted or propped following Cyclone Rae (1990) and a further 2,454 ha following Cyclone Sina (1990). Problems were once again experienced in 1993. Damage from Cyclone Kina and a series of fires, in turn partly related to a drought, was estimated at almost F$1m although this was partly offset by a F$0.47m exchange rate gain (on which no income tax is applicable). For the year overall, the company suffered a net loss of F$0.82m compared with a profit of F$0.46m in 1992 and expenditure on property, plant and equipment was reduced to help contain cashflow problems. Some 4,625 ha of 1–4

[25] For example, a pine tree harvested at 15 years will have an approximate diameter of $0.5m^3$ whilst a 20 year-old tree will have one of $1.25m^3$.

year old crops had to be propped or uprighted whilst planting operations were disrupted. A drought further delayed plantings in the last quarter of 1993 and only 1,274 ha of new forest was planted. Seed collection areas in Vanua Levu were also adversely affected as cones were blown off trees, necessitating a drawing down of contingency stocks. In 1994, a further F$1.4m of damage was incurred as droughts resulted in the spread of fires and some 1,100 ha, valued at F$1.26m, had to be written off.

For the period 1984–94 overall, Fiji Pine wrote off some 16,540 ha as a result of cyclones and fires whilst a further 22,339 ha were damaged by fires (Table 4.1). Over the shorter period 1984–90, the area restocked as a consequence of cyclones or fires (9,092 ha) was only slightly lower than that of new plantations (10,385 ha). In financial terms, cyclones and fire damage totalled over F$34.2m (at 1994 prices) between 1983 and 1994, compared with gross profits over the same period of F$323 7m. There can therefore be little doubt that Fiji Pine has suffered considerable damage as a consequence of a succession of natural disasters. Indeed, Fiji Pine is keenly aware of the risks posed by natural disasters. For example, in its 1994 Annual Report, protection of plantations against fires and cyclones were identified as 'the critical success factors for the company' (Fiji Pine, 1995). Moreover, since the 1960s, Fiji Pine has been involved in various activities precisely to reduce the cyclone vulnerability of the pine plantations. On-going tree-breeding and cross-breeding trials are being undertaken to develop a deep-rooted supple pine tree which would be better able to withstand cyclones. Experiments have also been carried out on patterns of planting, with trees planted in rows lying in the direction of the prevailing wind; and on the distance between trees, to assess whether cyclone damage can be reduced by widening the gaps between rows. The damage caused by Cyclone Oscar also partly prompted a re-examination of the choice of seed planted On the basis of both the cyclone damage and the shift in use of pine from chips to higher value saw logs, it was decided to use genetically improved seeds which produce straighter and more wind resistant trees. Meanwhile, efforts to minimise the impacts of fire have focused particularly on the construction of firebreaks and the stepping up of fire prevention activities during periods of drought

The primary objective of Fiji Pine is now to become self-funding with a planted pine estate of 64,000 ha by the year 2000. Until it achieves this goal, the corporation continues to be supported by government loans, effectively imposing additional pressure on government resources (see Chapter 9). It remains to seen when Fiji Pine will finally achieve the high export potential which it is widely perceived to have.

Table 4 1 Fiji Pine Commission production and financial performance

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Plantation acreage (hectares)												
Area planted	n a.	2,009	1,929	2,143	2,444	591	680	589	794	1,492	1,274	857
Area restocked (logging)	n.a.		109	393	160	620	683	664)	1,891	1,437	704	2,746
Area restocked (cyclone/fire)	n.a.	3,239	2,485	1,242	44	675	888	519)				
Cyclone and fire restocking as % total planting	n.a	62	55	33	2	36	36	29	70	49	36	76
Area logged	n.a	159	217	128	384	893	1,017	1,095	1,471	1,282	1,474	1,310
Area written off (cyclones/fire)	n.a	n a.	-	-	3,274	3,711	-	8,359	-	-	85	1,111
Area damaged by fires	n.a	n a.	122	892	12,297	-	65	79	512	2 905	626	4,841
Total estate area (hectares)	n a	n a	64,985	67,049	68,357	67,221	68,454	68,526	73 459	73,726	75,515	75 543
Planted area	33,263	37,685	42,063	45,150	44,101	41,428	40,871	33,671	35 632	37,566	37,291	38,519
As percentage total area			65	66	65	62	60	49	49	51	49	51
Financial data (real 1994 F$'000)												
Gross revenue	2,869	1,851	2,100	1,716	1,767	2,009	2,296	2,057	3,400	3,293	4,217	5,078
Operating profit	15	-29	-356	-728	-623	61	74	2	640	495	-670	613
Extraordinary items - of which -	-2,293	-1,113	-	-	-23,615	2,872	-745	18,776	166	10	-205	-1,223
Forest damage from cyclones and fires	-2,293 *	-1,113 *	-	-	-9,809	-2,872	-	15,927	-	-	-1,006	-1,261
Net profit (loss)	-2,278	-1,142	-356	-728	-24,238	2,933	-671	-18,774	805	505	-875	-810
Government budgetary appropriations (F$m)	12 0 *	13 5	10 5	33 1	7 9	4 6	5 5	3 0 *	6 4	3 6	3 5	3.3

Source: Fiji Pine Commission Annual reports, various

Notes
n a. - not available
* - net of insurance

4.3 Manufacturing

Since the late 1980s, the manufacturing sector has emerged as one of the country's key growth areas, generating most new jobs. By 1995, it accounted for 26% of total paid employment. The sugar industry alone accounted for 28% of manufacturing output in 1992–4.

The manufacturing sector is vulnerable to natural disasters primarily via their impact on plants, equipment and inputs. Temporary breakdowns of electricity, telecommunications and transport networks, including shipping, can also disrupt productive and marketing activities (see Box 3.2).[26] In addition, disasters can affect patterns and levels of consumption and, thus, demand for manufacturing products. However, the precise nature and magnitude of all such impacts is dependent upon the structure of the sector, existing stock levels, the price elasticities of demand and supply for intermediate and final consumer goods and the openness and composition of external trade. The extent of insurance coverage also plays a role, as discussed in Chapter 10.

The results of the regression analysis presented in Chapter 3 and Appendix 1 indicate that the manufacturing sector has, in fact, become increasingly vulnerable to natural disasters since the early 1980s, as compared with the first 12 years of Independence. However, regressions for the later period excluding sugar manufacturing suggest that this increasing vulnerability largely reflects developments in the sugar industry (see section 4.1) while non-sugar manufacturing has remained relatively immune to disasters.

There is some evidence to suggest that this vulnerability may decline again in the future. Since the late 1980s, there has been some diversification of the manufacturing sector out of sugar and, with further diversification as well as a decline in sugar production itself, as expected, the sector could gradually become less vulnerable to disasters. However, any reductions in vulnerability would not represent deliberate efforts on the part of the government: the government has deliberately created more favourable conditions to attract new industries but has not targeted any particular industries – be they more or less disaster-prone – specifically.

The garment industry has shown particularly strong growth, emerging both as the country's second largest merchandise exporter in 1989 and as one of its main

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[26] A study of the vulnerability of the Fiji power sector to various hazards estimated that the sector scored 12 out of 19 (minimum score = 4) for risk of damage from the environment, including earthquakes and tsunami; and 19 out of 29 (minimum score = 4) for risk of damage from windstorm (Pacific Power Association internal report, no date).

employers, accounting for around 12.4% of total paid employment by mid-1995. The garment industry already had a base in Fiji prior to 1987 but the 1987 devaluation and the subsequent introduction of trade liberalisation and tax and export incentives stimulated rapid growth in the industry. Development was further encouraged by preferential market access to Australia and New Zealand. More recently, Fiji also managed to penetrate the US and European markets, operating on a more competitive basis and effectively establishing itself a potentially more secure market for the future. The garment industry has been one of the few areas attracting foreign investment (World Bank, 1995).

In terms of the implications for the disaster vulnerability of the manufacturing sector more generally, the garment industry is relatively immune to natural disasters and has suffered very little damage to date. The industry essentially manufactures garments from imported materials and then re-exports the bulk of its output. Most of the industry is located in the Suva area, with imports and exports channelled through Suva port. This implies that the industry is largely independent of domestic demand and supply or internal transport infrastructure. Only one company was reported to be adversely affected as a consequence of Cyclone Kina, for example, suffering some F$1m damage to materials and fabrics as a consequence of flooding. However, a major earthquake in the Suva region could have more catastrophic implications for the industry.

The fishing industry has been another important area of growth and, again, appears to be relatively immune to natural disasters except in terms of the vulnerability of fishing infrastructure, such as boats and harbours, and of fish habitat, such as coral reefs. High levels of sedimentation due to soil erosion, in turn often the consequence of heavy rainfall, can have an adverse impact on inshore and freshwater fisheries (Porter, 1994).

Fiji has also begun to develop a few other niche manufacturing sub-sectors but these, too, have apparently suffered little overall damage to date as a consequence of natural disasters. More generally, much manufacturing output is exported, reducing the importance to the industry of healthy domestic demand, whilst some sub-sectors are also sourced from imported inputs, again reducing the linkages with the disaster-vulnerable domestic economy. However, any growth in agro-processing industries or timber and furniture production could imply increased vulnerability and hazard risks should certainly be taken into account in any overall planning exercises or risk reduction strategies. Probably one of the issues of most concern is the relative concentration of manufacturing plants in the Suva/Nausori area. A severe cyclone or earthquake in this area could cause extensive damage to the manufacturing industry. To avoid further concentration of industries in more hazard-prone areas, the location of any dedicated tax free factories or industrial parks, which implicitly entail a concentration of industry, should be carefully appraised in terms of their vulnerability to all types of natural disaster. All potential investors should also be encouraged to undertake proper hazard risk assessments before deciding on the location of their plants.

4.4 Investment

Levels of investment have been consistently low in Fiji and considerably below those of domestic savings. This has primarily reflected concerns about the country's political stability; lack of confidence in the government's commitment to sustain and implement policies; the country's inability, to date, to secure sustained economic growth; the high costs of conducting business in Fiji;[27] and, more recently, the implications of international trade liberalisation and uncertainty over the renewal of land leases.[28] However, increased levels of investment are particularly important in securing future growth and efforts to stimulate investment have featured heavily in government policy. It is therefore relevant to consider the potentially adverse impacts of natural disasters on levels of investment.

Sudden-impact disasters damage and destroy capital stocks and infrastructure, conceivably boosting levels of investment as lost assets are replaced, with certain potentially beneficial multiplier effects (see Box 4.1). Some of the main infrastructural impacts of Cyclone Kina, for example, are illustrated in Box 3.2. However, subsequent reconstruction and rehabilitation efforts may not increase the net capital stock except to the extent that they entail upgrading.[29] Meanwhile, disasters can act as a disincentive to new investment – or even to the replacement of existing investment – especially in their immediate aftermath when perceptions of hazard risks are heightened. In assessing investment performance in post-disaster circumstances it is therefore important to distinguish between investment, which replaces or repairs destroyed and damaged assets, and new investment, which may be depressed.

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[27] For example, telecommunication, freight, building and infrastructure costs are high. Some potential tourism industry investors are also discouraged by the high international travel costs to and from Fiji.

[28] Currently 83% of land is communally-owned by indigenous Fijians whilst the remainder is leased to non-Fijians by the government. Between 1996 and 2000, 40% of long-term native land leases are due for renewal. Uncertainty about the outcome of this process is apparently having a major impact on levels of investment in rural-based activities (ADB, 1995).

[29] Total investment figures will also partly reflect the government's practices in recording rehabilitation expenditures in terms of the shares of that spending accorded to capital and recurrent expenditure.

Box 4.1 **Construction**

Cyclones, floods and other sudden-onset disasters can cause severe damage to buildings as well as transport and other infrastructure, One might therefore expect an upturn in conservation activity in the aftermath of such disasters. Some even argue that in the longer term natural disasters can generate a construction-led economic boom (e.g. Albala-Bertrand, 1992),

In practice, it is difficult to identify any impact of natural disasters on the Fijian construction industry in recent years although an earthquake causing heavy damage in, say, the Suva area would probably precipitate substantial construction activity. Physical damage from cyclones is typically less severe, often involving repair rather than total reconstruction; and may be undertaken by homeowners or tradesmen operating informally. There are also certain measurement problems to the extent that construction activity can fluctuate significantly between years, depending on the status of a few larger projects. For example. construction activity was expected to slump in 1983 following the near completion of the Monasavu hydroelectric scheme although several cyclones were reported to have stimulated some private construction activities which would continue into 1984 (Fiji Government, 1983). Similarly, in 1993 despite increased construction activity at the beginning of the year to repair damage caused by Cyclone Kina, annual output fell by 25.5%, year on year largely owing to the completion of reclamation works under a major development project (1994 Budget Supplement). Meanwhile the increase in construction activity observed in 1985 was principally due to the commencement of some major construction projects rather than cyclone-related reconstruction.

The Building Price Index also provides little real evidence of any post-disaster construction boom, which would be expected to increase the price of building materials as demand for them rose. However, some temporary shortages have been reported in the aftermath of disasters, particularly of the two main roofing materials, corrugated iron and timber. It takes 6–7 weeks to import additional supplies of corrugated iron from Australia. Meanwhile, Fiji has an embargo on the import of timber, exacerbating potential shortages arising not only from increased demand but also from lower supply if the disaster disrupts timber production and transport operations. Shortages of timber can last 3–4 months.

In practice, there is no discernible pattern of the impact of natural disasters on rates of investment. Gross domestic investment showed an almost continuous real year on year decline between 1981 and 1987 and again from 1989–93, excluding 1991 when non-disaster-related factors dominated investment performance. There is also little evidence of post-disaster investment booms linked to the construction industry, although a severe earthquake could potentially result in a substantial increase in investment. Meanwhile, natural disasters have generally not been perceived as a disincentive by potential investors who, instead, appear to be almost unaware of the notion of hazard risk. For example, most prospective investors do not seek any advice on disaster risks from the Fiji Trade and Investment Board (FTIB). The few who do, receive informal advice based on the FTIB staff's own knowledge. The FTIB was also unaware of any would-be investors who had enquired about earthquake risk;[30] of any investors who had altered the proposed site of their investment to reduce the hazard risk; or of any investors who had withdrawn from Fiji following damage incurred as the consequence of a natural disaster.

The tourism industry provides another example of would-be investors' apparent lack of concern about the risk posed by natural hazards. Although some tourist resorts have suffered considerable damage as a consequence of natural disasters, this does not appear to have deterred foreign investors. For example, a number of resorts suffered damage during the 1985 cyclones yet construction of some major projects, including the Sheraton Hotel in Nadi, were begun the same year.

[30] Instead, prospective investors presumably receive most of their hazard risk information from the insurance industry.