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AGRICULTURAL RISK MANAGEMENT OPTIONS FOR THE FRUIT AND VEGETABLE SECTOR IN SAMOA

REPORT

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ALL ACP AGRICULTURAL COMMODITIES PROGRAMME

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Abbreviations

AAACP	All ACP Agricultural Commodities Programme
ARMT	Agricultural Risk Management Team
CCRIF	Caribbean Catastrophe Risk Finance Facility
CRMG	Commodity Risk Management Group
DBS	Development Bank of Samoa
DMO	Disaster Management Office
ECLAC	Economic Commission for Latin America and the Caribbean
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
F&V	Fruit and Vegetable
FAO	Food and Agriculture Organisation
GoS	Government of Samoa
HTFA	High Temperature Forced Air
ICCAS	International Climate Change Adaptation for Samoa
IGO	Intergovernmental Organisation
IO	Implementing Organisation
ISDR	International Strategy for Disaster Reduction
ITC	International Trade Centre
MAF	Ministry of Agriculture and Fisheries
MNRE	Ministry of Natural Resources and Environment
NGO	Non Government Organisation
PCRFI	Pacific Catastrophe Risk Financing Initiative
PFIP	Pacific Financial Inclusion Programme
SACEP	Samoa Agricultural Competitiveness Enhancement Project
SAME	Samoa Association of Manufacturers and Exporters
SBEC	Samoan Business Enterprise Centre
SCE	Single Crop Equivalent Area
SFA	Small Farmers Association
SIAM-2	Second Infrastructure Asset Management Project
SOPAC	Pacific Islands Applied Geoscience Commission
SPC	Secretariat of the Pacific Community
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
WIBI	Women in Business Incorporated

Executive Summary

1. The fruit and vegetable sector in Samoa is characterized by subsistence farmers growing for home consumption, on customary land, with few commercial producers. There is scope for import substitution and exports, a F&V sector strategy has been developed, and several programmes, including the Samoan Agricultural Competitiveness Enhancement Programme (SACEP) are under development with the government of Samoa. The F&V supply chain is reviewed, in relation to risks and constraints faced by the sector, and to possible risk management options.

2. Cyclone is the key unmanageable risk faced by the agricultural sector, in terms of potential for widespread, significant damage, and where an insurance mechanism could benefit Samoa. The annualised cost of damage to the agricultural sector from major cyclones has been estimated as 6% of GDP or USD 30m per annum. Market based crop insurance at an individual farmer level, whether traditional indemnity insurance, or index crop insurance, is not considered as operationally or financially viable for perils other than cyclone.

3. Samoa benefits from strong disaster planning. Strengthening the disaster risk management planning and implementation by the Disaster Management Office (DMO) provides an excellent backbone for practical implementation of preparedness, and planning of relief, recovery, post-event food security, from hazards and particularly cyclone, in the agricultural sector. Linking the financing of in-kind recovery needs, and/or payouts to affected households, through insurance linked to the DMO, could be feasible. The linkage of index based insurance with the DMO is considered more realistic than distribution to individually insured farmers through other channels.

4. Such a proposal would be most likely to be feasible if structured, in a first stage, where DMO (or other designated government agency) was the policyholder for a triggered index policy (a "macro" scheme). Payout rules would be established based on DMO assessment methodology including damage assessment linked to farmer registration. However, a second and later stage could be foreseen, where farmers could individually purchase indexed cyclone cover as a top-up to the cover provided under the DMO plan .

5. Building a layered structure for risk financing is outside the scope of this report, but could include development of a fund, backed by reinsurance, the Pacific Catastrophe Risk Financing Initiative, and the widely available donor funding. An advantage of the insurance and reinsurance approach is a faster and more pre-planned financial response to major events than is possible by ad hoc and ex post donor funding and appeals. Although risk transfer is important, the most important initial consideration relates to ground-up planning of strengthened agricultural risk management measures.

6. Apart from cyclone (and tsunami or volcanic eruption), most risks to agriculture are non-catastrophic are to a large extent controllable by good farm management practices. Traditional crop insurance, or index insurance adapted to these other perils, is not considered realistic or feasible in Samoa due to the predominance of subsistence farmers, and due to the lack of a business case for the insurance sector, from the limited number of commercial producers. Programs which strengthen the value chain (e.g. markets, improved inputs) and promote good agricultural practices, and informal risk management mechanisms, such as savings, community based actions as well as governments' efforts in disaster planning, can all contribute to risk improvement for the F&V sector, and overall food security. Microfinance and microinsurance can contribute to security of small scale farming households, even if agricultural insurance is not available.

7. Access to finance, and the availability of agricultural credit, remains an issue which would only partially be addressed even if formal insurance against cyclone was introduced. Multiple Peril Crop insurance (which approaches to a production guarantee) is not feasible in Samoa. Access to credit is a concern mainly for emergent or commercial farmers. Systems which can enhance collateral, develop supply chain finance through contractual arrangements to domestic buyers and exporters, pre-agreed loan rescheduling, and formal development programs providing investment funds linked to technology and extension services, can contribute to managing localised losses and production volatility. Achieving improved productivity and profit reduces risk, although commercialisation can result in less crop diversification.

Chapter 1: Introduction and Objectives

1.1. This study is undertaken as a part of the Pacific Regional Work Plan of the All ACP Agricultural Commodities Programme (AAACP), a programme financed by the EU and being implemented by several Implementing Organisations (IO's), including the Agricultural Risk Management Team (ARMT – formerly Commodity Risk Management Group, CRMG) of the Agriculture and Rural Development Department of the World Bank. The workplan for the region was decided after a workshop attended by representatives of the Pacific islands, held in Samoa on 27 -29 February 2008. The fieldwork for the present study was delayed as a result of the tsunami which impacted Samoa on 29 September 2009, and was carried out on 19-26 June 2010.

1.2. Samoa is highly exposed to natural hazards (particularly cyclones, associated flooding and volcanic activity). 80% of the population of 185,000 lives in rural areas, and agriculture employs some two thirds of the labour force. In spite of high increases in per capita GDP over the last 15 years, a concern is that per capita agricultural production has decreased. Samoa relies heavily on food imports, and the Government of Samoa (GoS) has set a priority for agricultural development, in order to increase agricultural income and exports, to promote import substitution, and improve food sufficiency and security[1]. Combined with the strong concern over the potential impact of climate change on agriculture, there is increasing interest in managing the risks faced both by farmers and by supply chain actors, and in the potential for a more formal approach towards risk management which could support government objectives.

1.3. The objectives of the present study were a) to identify a weather risk management strategy for the agricultural sector, with special emphasis on the fruit and vegetable sector; b) to assess weather risk exposures and to determine the options for market based instruments, particularly weather index based insurance; c) to assess the barriers to insurance market development and access to finance; d) determine whether provision of coverage foreseen under the Pacific Catastrophe Risk Financing Initiative could be adapted to meet needs under (c); and e) to identify practical solutions for improved risk management and access to finance for the fruit and vegetable sector. While the focus of the study was the fruit and vegetable sector, weather risk exposures to plantation crops were also addressed in the study.

1.4. There are several initiatives in Samoa which relate to the objectives of improving productivity, and market development both for domestic and for export crops. MAF has set goals of improved food security, improved commercial development and sustainable agricultural production[2]. IO's actively involved in Samoa under the AAACP Pacific programme include the International Trade Centre (ITC), who, working with a group of stakeholders under the Fruit and Vegetable Committee, developed a Fruit and Vegetable Sector Strategy for Samoa, delivered in draft in July 2009. The Food and Agriculture Organisation (FAO) and UNCTAD are jointly undertaking survey and development work on supply chain finance for the fruit and vegetable sector. The World Bank is working with GoS to finalise a loan, to support the Samoa Agriculture Competitiveness Enhancement Project (SACEP), with the aim of strengthening key value chains, including fruit and vegetable. UNDP are working on climate change adaptation programmes for the region and for Samoa. Samoa has a well established disaster management office and comprehensive strategy for disaster risk management, and donor and NGO activity are at a high level in many sectors. The current study is therefore undertaken within a crowded space and with overlapping interests, but fills a gap in addressing formal and informal risk management mechanisms for agriculture, and assessing the possible role of agricultural insurance.

[1] Strategy for the Development of Samoa, SDS, 2009-2015.
[2] http://www.maf.gov.ws/

1.5. Chapter 2 reviews the F&V sector, and the organisations which serve the supply chain. Chapter 3 analyses the production risks and constraints faced by the F&V sector. Chapter 4 reviews current practices for risk and disaster management in Samoa, relevant to the agricultural sector. Chapter 5 sets out options and conclusions for future risk management, for consideration by GoS.

Chapter 2: The Fruit and Vegetable supply chain in Samoa

2.1. This chapter reviews the participants in the F&V supply chain in Samoa, and some specific initiatives to improve commercialization and competitiveness.

Producers, production systems and land use

2.2. There are estimated to be about 19,000 rural households, living in 360 villages and sub-villages on the two main islands, Upolu and Savai'i. The rural population is around 145,000 and 40,000 are in urban areas, principally in Apia. Rural life is strongly influenced by the traditional village structure, which is governed by councils of chiefs as semi autonomous entities. Customary land accounts for 80% of land area, 16% is owned by government and 4% of land area as owned freehold. Parts of customary, government or freehold lands are leased.

2.3. 80,500 ha or 28% of land mass of Samoa is under regular agricultural or livestock production. The 2004 FAO survey classified the agricultural area as 53,000 ha of plantation crops, 10,000 ha of mixed cropping, and 17,500 ha of grassland. The balance of land area is forest, secondary forest, scrub or other land use. Cropping area from the 1999 agricultural census, expressed as Single Crop Equivalent Area (SCE), after adjusting areas of mixed cropping and scattered cropping, is shown in Table 2.1. The SCE figures of 107,700 acres (43,600 ha) reflect that over much of the productive area, tree and crop production is dispersed and not intensive. Plantation agriculture, principally coconut and cocoa, is largely on government or freehold land. Land use in Samoa is shown in Figure 3.18

Table 2.1

Single Crop Equivalent Area[1] Samoa 1999

Crop	**Area in household sector[2] (acres)**	**Total area (acres)**
Coconut	46,300	53,200
Cocoa	9,900	10,400
Taro	10,500	10,500
Taamu	11,900	11,900
Banana	10,700	10,700
Yam	1,300	1,300
Kava	3,000	3,000
Other crops	6,700	6,700
Total	100,300	107,700

Note 1: Single crop equivalent area is an estimate of area under each crop type, after adjusting for mixed and scattered cropping. *2: customary land areas

Source: 1999 census of Agriculture Report, Department of Statistics, table 5.18.

2.4. The majority of farming households in Samoa are living on customary land, and produce food for their own consumption within extended family units. Farming is labour intensive and on small areas of cultivated land, typically with plots of less than 1 ha, and with few holdings as much as 10 ha. MAF estimates that only a small proportion, around 25%, of farm households are engaged in formal markets. Key crop types are coconuts, root crops (particularly taro, taamu and yams) and fruit (particularly pineapple, papaya, breadfruit, citrus, avocado, mango, guava) and vegetables (particularly peppers, tomatoes, cabbage). Small livestock (particularly pigs) are kept under mixed farming.

2.5. There is very limited statistical data available on areas, production and yield of different crop types, or of household and other data. However, the census results include the number of mixed plots where each crop type is grown. Agricultural censuses are conducted on a 10 year cycle. The last published agricultural census was in 1999, but a census was undertaken in 2009, which is in the course of analysis and will be published later in 2010. An agricultural survey was undertaken in 2005. Quantitative data is available on imported and exported food products; and on volumes (and prices) of goods marketed through the Fugalei market.

Fruit and vegetable sector value chain actors

2.6. The Fruit and Vegetable Sector Strategy report[3] provides a comprehensive overview of the F&V sector, and identifies constraints, strategic objectives and interventions. A more detailed analysis has been made of the value chain for selected products (papaya, breadfruit, head cabbage and tomatoes) by FAO[4], also under the AAACP programme. Technical assistance is also being provided by World Bank to GoS on supply chain competitiveness, farmer support services and infrastructure needs and policy in preparation for the SACEP project. This technical assistance includes work by consultants specializing in the F&V sector.

2.7. There is a relatively small number of producers who are fully dedicated to commercial F&V production, either domestically or for export. Supply for the domestic market is principally the surplus production of households growing F&V for home consumption. Dedicated supply chains, where farmers grow for specific markets, according to predicted demand or orders, are very limited. Generally there is a disparity between quite organised buyers for the hotel trade or for export, and the status of supply organization to meet the demand for consistent quantities, timing, and quality. This disjoint in distribution channels is well understood, and strategies identified to address it have been proposed in the Strategy document, through organization of hubs for local collection, and by creating farmer groupings, and by promotion of dedicated commercial farms concentrating exclusively on producing to meet the demands of the market. Currently low levels of technology at the production level are easier to overcome with commercially oriented farmers, than with households selling part of their production.

2.8. In terms of **input supply**, the analysis by E. Tamasese shows that supplies of inputs of seeds, fertilizers and other inputs are not well organised, particularly in terms of consistent or timely availability of improved seeds or planting materials at distribution points of sale, for the crops studied.

2.9. The technical support and **extension services** available to farmers is limited. MAF have six extension officers (each dedicated to a specific crop group), who operate village workshops and open days, and provide advice to farmers. MAF have also, from time to time, operated stimulus packages (e.g. the current Replanting Package for Coconut, Cocoa and Coffee). The **Samoa Farmers Association** (SFA), although with a limited membership of about 110 (mainly commercial) farmers, provides advisory services, as well as sourcing improved varieties and inputs. **Women in Business** Inc (WIBI) is a notable success in terms of an integrated programme developing both markets for **organic F&V**, with over 350 registered organic farms and more in the process of registration; organic producers also supply a domestic Organic Farmers Market and basket deliveries. WIBI also offer “hands-on” technical assistance to their farmer members. WIBI has organised certification and export of some products such as bananas, limes and vegetable oils, with the most prominent success being the supply of coconut oil to retail chain The Body Shop.

2.10. **Access to Finance** was cited frequently on the mission as a significant constraint, although it was also noted that there is low demand from subsistence farmers for agricultural loans. The **Development Bank of Samoa** (DBS) provides finance and stated that it has some 5,000 loan accounts

[3] AAACP (2009): Fruit & Vegetable Strategy for Samoa. ITC/FAO.
[4] Tamasese, E (2009). An analytical study of selected fruit and vegetable value chains in Samoa. FAO, AAACP paper series no.11.

with agricultural households, and 60 loan officers based at headquarters. The loan portfolio of the DBS in agriculture[5] show that 25% of DBS loan approvals in FY 2009 were to agriculture, and amounted to WST 5.25 million (625 loans) principally for taro, banana, piggeries and cattle. The total agricultural loans portfolio stood at WST 17.6 million at the end of the FY. Provisions for bad loans were 11.1%.

2.11. In the case of small farmers, loans require personal guarantees from persons of standing in the community (often salaried government employees). Customary land cannot be used as collateral. Interest rates are in the region of 12%. Loans to agricultural sector have been decreasing. Loans have short repayment schedules, which may not be aligned with the production cycle of different crop types. **Commercial banks** dominate private sector lending but do not provide significant levels of financing to agriculture, and where they are it is mainly to commercial farmers. Commercial bank credits to agriculture, forestry and fisheries are an extremely small proportion of commercial lending[6]. The **Samoa Business Enterprise Centre** (SBEC) operates a guarantee scheme against loans of approximately WST 1 million, of which about one-quarter are for agriculture, funded principally by NZAid. An analysis of supply and demand for agricultural credit was undertaken by FAO in 2009[7].

2.12. **Remittances** form a very significant role in household finances, amounting to a total of WST 366 million in 2008/09[8], originating principally from the Samoan diaspora in NZ, Australia and the USA, and through churches. These remittances increased after the 2009 tsunami.

2.13. The Samoa Association of Manufacturers and Exporters (SAME) represents the **processing and manufacturing** sector in Samoa, including agriculture. Export crops were limited in 2010 to weekly air shipments to NZ of Tahitian limes and Missiluki bananas; to export of tomatoes and cabbage to American Samoa, and a recent resumption of taro shipments to NZ. Exports are dependent on export champions (active exporters), and organisations such as WIBI or individual taro exporters. Manufacturing is carried out by a few firms, producing dried chips, noni fruit juice (some of which is also exported) etc. However, these activities are minor in comparison to the sales of fresh produce for the domestic market, and demand for processed products is met through imports. As noted, the hotel and wholesale trade are obliged to import the majority of fresh and processed produce in order to ensure consistent supplies and quality. There is a High Temperature Forced Air (HTFA) treatment plant, currently employed to treat thrips, mealy bug and scale on the exported bananas and limes. Potential for developing market segments for Domestic and Export, Fresh and Processed produce, including specific products identified for future development form part of the F&V sector strategy report.

2.14. To supply the domestic market, the normal **marketing channels** are roadside or village selling, or through the Fugalei market in Apia. Transport via pickup is organised by local transporters, or by farmers (or groups of farmers) themselves. Wholesalers supply retail outlets and hotels, and the retail and foodservice channels can be considered well organised, in comparison with lack of organization within the supply side of the value chain.

2.15. There is a marked **volume and price variation** of produce sold per month at the Fugalei market: after the rainy season in January to April, volumes are low, and prices high. Supplies increase in June to October, resulting in price falls. There is a lack of crop calendarisation to provide market supply, and supplies reflect that growing vegetables in the rainy season is more challenging and not pursued. There is a lack of information on market and buyer requirements, grades, and low awareness.

2.16. The **insurance sector** is well developed in Samoa. However, classes of insurance which are offered are geared to the commercial, industrial, property and motor insurance. According to a

[5] Development Bank of Samoa: Annual Report 2009.
[6] Central Bank of Samoa (CBS) quarterly bulletins.
[7] FAO, 2009b. Supply chain finance and risk management for Samoa's fruit and vegetable sector: issues, constraints and potential solutions. Draft report.
[8] CBS Annual Report for the financial year July 2008 to June 2009.

2006 report under the SIAM-2 project[9], government buildings were commercially insured, most commercial businesses were insured for their assets (but not for business interruption), and about 50% of homes (but not traditional fales) were insured. About half of those insured were covered for catastrophe risks (e.g. cyclone) in addition to fire and allied perils. These are high rates of uptake based on international comparisons. However, households who were most vulnerable to natural disasters were least likely to have their property insured. In contrast to urban insurances, the rural insurance services available to agricultural producers do not extend to productive assets such as crops and livestock. This is the norm for smallholder agricultural sectors in most countries, and is not unexpected in Samoa, considering that agricultural production is primarily on a substance basis.

2.17. Financial **gross margin data** for a wide range of F&V products have recently been developed under the Agriculture component of the Integrated Climate Change Adaptation for Samoa (ICCAS) Project. For perennial crops, these budgets are estimated annually over the cycle of the crop. Costs include labour, and an estimate of revenue sensitivity is shown for price and yield. These data are very valuable to those farmers considering moving into commercial production, even if the levels of inputs and intensity are not followed by subsistence farmers. Further detailed analysis is made of four specific supply chains of papaya, breadfruit, head cabbage and tomatoes by Tamasese (2009). A significant cost in the investment in production is need for initial clearance of rocks, which is required to achieve annual cropping on any scale. Analysis of field-scale investments in commercial crops, including some such as onion not currently grown in Samoa, was carried out by SACEP consultants, and show promising levels of potential profitability, even after land clearance and provision for investment in drip irrigation and in-field shelters to protect crops during the rainy season. Such irrigation and water management measures are considered necessary if commercial producers are to achieve consistent monthly production as demanded by the market. Generally, these studies show encouraging potential returns from F&V production in Samoa.

[9] MNRE, 2006: SIAM-2 component C-4, Disaster Insurance for Samoa. Beca International Consultants. Available on the MNRE website.

Chapter 3: Risk Assessment : Samoan Agriculture

Overview

3.1. Samoan agriculture faces a number of risks which can adversely affect farm income. These can be broadly grouped into production risks, such as adverse weather conditions, and market risks such as prices. There are also a number of constraints to farm production. A distinction between risks and constraints allows their categorization, and development of strategies for management. Risks are unforeseeable events which cause loss (for example, weather, natural hazard, health of the farmer or accidents). Constraints are predictable activities and circumstances which reduce farmer productivity and income (for example, ineffective supply chains, access to finance or markets, non-availability of inputs or low technology).

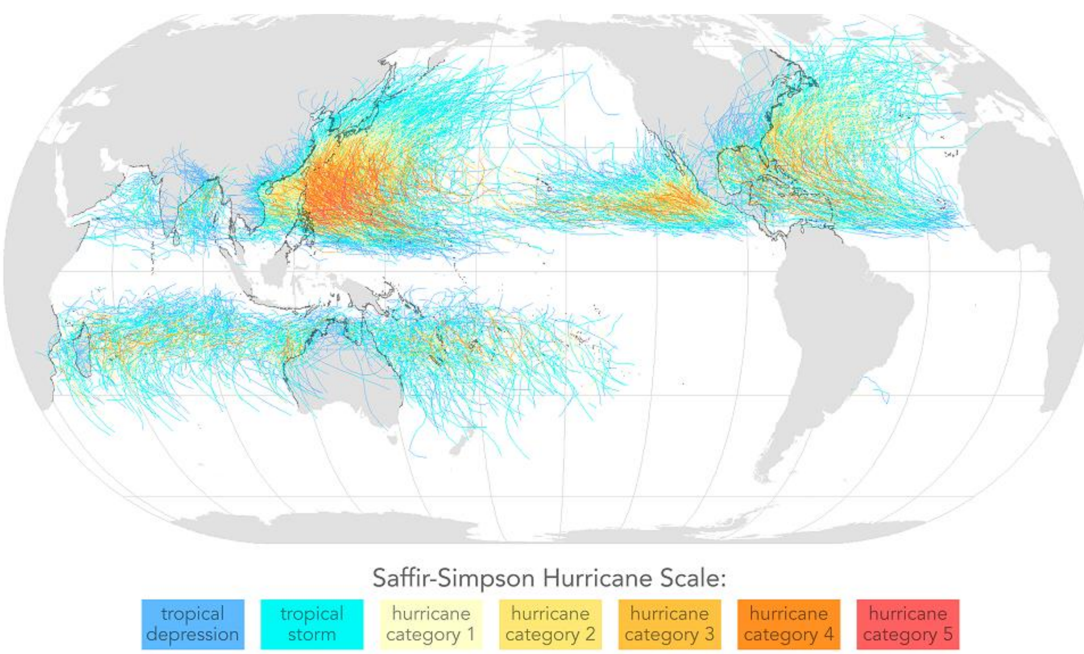
Production Risks

3.2. The main production risks relate to either weather events or pest and disease outbreaks. The predominant weather risk in Samoa is tropical cyclone, capable of causing widespread and severe agricultural losses. Other important weather risks for agriculture are flooding, which is typically localised, tsunami, which has a low frequency of occurrence and is also localized to coastal areas, and excessive rainfall. Pest and disease outbreaks have had an important historical impact on Samoan agriculture, with both the taro and papaya industries suffering recent losses. Other agricultural production risks are not considered to be of sufficient frequency and or/severity to be considered further in this report.

Tropical Cyclone

3.3. The Pacific Islands lie in a belt of cyclone activity (figure 3.1), although only around 11% of the world's cyclones form in the South Pacific. An average of 9 cyclones form in the South Pacific each year, based on records from 1970 to 2006, with a range of 3 to 17 per annum. Not all of the reasons for the

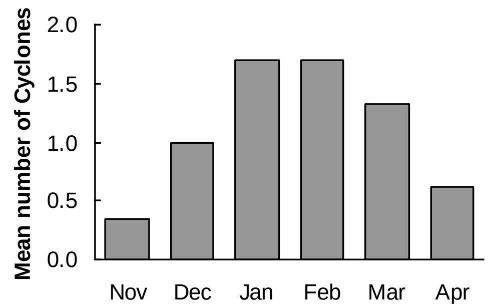
Figure 3.1: Tropical cyclone tracks for the period 1945 to 2006, mapped using data from the Joint Typhoon Warning Centre and the US National Oceanographic and Atmospheric Administration.



variability in annual numbers is understood, but an important influence is the Southern Oscillation Index, with strong El Niño conditions leading to an increase in tropical cyclone activity of 28% above average[10]. During El Niño conditions, cyclones also tend to form further to the north and east, and the cyclone season may start earlier and/or last longer.

The tropical cyclone season, when more than 95% of South Pacific cyclones form, occurs from November to April, which coincides with hot and wet conditions in Samoa. South Pacific tropical cyclones are most likely to form in January, February and March and from 1970 to 2006 over 68% of all tropical cyclones formed in these months. The main influence in cyclone formation is the high sea surface temperatures occurring in the summer months[11].

Figure 3.2: Mean number cyclones per month in the South Pacific region.



Cyclones mostly form to the northwest of Samoa and track to the southeast. Cyclones tend to form in the west because sea temperatures are higher than in the east. There is a distinct pattern in the annual frequency of cyclones, with decreasing activity east of about 160^0E longitude (Samoa lies at about longitude 172^0W longitude). This pattern is disrupted during El Nino periods with cyclone formation as far west as 140^0W longitude.

Table 3.1

Saffir – Simpson Scale

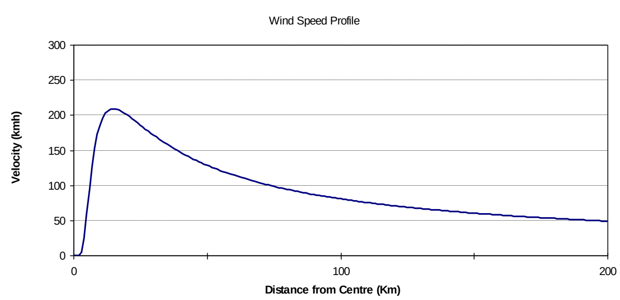
Category	Windspeed (km/hr)
Tropical Depression	0 to 62
Tropical Storm	63 to 117
Category One	117 to 153
Category Two	154 to 177
Category Three	178 to 209
Category Four	210 to 249
Category Five	250 or more

Tropical cyclone intensity is most often measured using the Saffir-Simpson scale, according to the maximum sustained windspeeds (ie: lasting more than one minute and measured at an altitude of 10m).

Tropical cyclone tracking and recording by satellite became available in the 1969-70 cyclone season, and while earlier data is available, this is not as accurate.

Cyclone intensity tends to decline rapidly from the core. While the profile of every cyclone is different, a typical windspeed profile is shown as figure 3.3. The shape of the curve remains similar for all cyclones. In the example shown, at a distance of 100km from the core, the windspeed is half the maximum which occurs at the edge of the core.

Figure 3.3: Typical cyclone wind profile



Cyclones in the South Pacific generally last for 3 to 8 days, with 67% falling into this category, and the most common duration being 4 days. The longest duration recorded is 26 days. Cyclones travel at an average speed of under 25 km/hr, equivalent to 600km per day. Cyclones generally move more slowly when they first form.

[10] Basher, R, E, and Zheng, X. 1995. "Tropical cyclones in the southwest Pacific: spatial patterns and relationships to Southern Oscillation and sea surface temperature." Journal of Climate 8:1249-1260.

[11] Revell, C,G, and Goulter, S,W. 1986a. "South Pacific tropical cyclones and the Southern Oscillation." *Monthly Weather Review* 114:1138-1145.

History of Tropical Cyclones near Samoa

3.4. Figure 3.4 shows the tracks of tropical cyclones and tropical depressions which have come within 250km of the coastline of Upolu or Savaii[12]. In the 66 year period there have been 11 cyclones which have tracked within 250km of Samoa's coastline. In many cases the cyclones had declined in intensity to tropical storms by the time they reached the closest point to the Samoan coastline. Figure 3.4 shows the tracks of all 11 cyclones and figure 3.5 shows the tracks of those cyclones which were at category 3 status or higher by the time they reached their closest point to the coastline, and which came within 250km of Samoa. The most intense cyclones are shown in Table 3.2.

Table 3.2

Intense Cyclones close to Samoa

Cyclone	**Description**
Ofa 1990	Category 3 at 120km, Category 4 at 170km
Val 1991	Category 4 at landfall
Heta 2004	Category 5 at 140km
Olaf 2005	Category 5 at 125km

Figure 3.4: Tracks of all cyclones which have come within 250 kilometeres of the coast of either Upolu or Savaii from 1945 to 2010.

[12] Best Track Data from the Joint Typhoon Warning Centre.

Figure 3.5: Tracks of all cyclones which have come within 250 kilometeres of the coast of either Upolu or Savaii, which were category three or higher at their closest point to the coast. Tracks from 1945 to 2010

Modelling Tropical Cyclones

3.5. Since weather events such as cyclones have a relatively low frequency of occurrence and there is consequently a limited database of historical records, modern risk management relies on modelling to refine assessments of expected frequency and severity. Modelling relies on the simulation of many storms, by specifying the probability distribution of several variables, based on what has actually occurred in the past. Each variable is then sampled to produce a much larger database of possible outcomes than the actual number of recorded storms. For tropical cyclone modelling, the variables which are considered usually include the starting location, central pressure, eye radius, forward speed and life cycle. The model can then produce simulated windspeeds and intensities at any point along the cyclone track of each modelled cyclone. Windspeeds may be further adjusted for terrain and topography. Models usually simulate at least 10,000 individual events.

Comprehensive cyclone modelling has been completed by the catastrophe risk modelling company AIR Worldwide for eight pacific islands including Samoa. The results were presented in the World Bank report Pacific Catastrophe Risk Financing Initiative[13]. This report concluded that a category one tropical cyclone would come within 100km of Apia with a frequency of once every 8 years, and a category three storm once every 35 years (Table 3.3). The most severe tropical cyclones, of category 4 and 5, occur at only a very low frequency.

Table 3.3
Modelled Tropical Cyclone Frequency for Apia

Category	Frequency (years)
Category One	Once every 8 years
Category Two	Once every 13 years
Category Three	Once every 35 years
Category Four	Once every 185 years
Category Five	Once every 3333 years

[13] Roberts, Nigel, Mahul, Olivier, and Shuker, Iain. 2007. “Pacific Catastrophe Risk Financing Initiative.” World Bank. Washington, DC.

Damage Caused by Tropical Cyclones

3.6. In recent years three tropical cyclones have caused substantial losses to agricultural production in Samoa; cyclones Ofa in 1990, Val in 1991 and Heta in 2004. Cyclones Ofa and Val, which were the most damaging, affected Samoa with extreme weather conditions for a period of more than 3 days each. However, a number of less severe cyclones, of intensity less than category 3, have caused smaller losses. Damage from cyclone is primarily caused by wind, but also by heavy rain associated with the winds. Rainfall volumes associated with cyclones are high and so is rainfall intensity. Weak cyclones are just as able to produce high rainfall volumes as intense cyclones. Distant tropical depressions and tropical storms can result in very high rainfall, even if not close enough to generate high winds. In Samoa, daily rainfall events in excess of 200mm are common, with Apia recording such events every 3½ years on average. Data on expected return periods for rainfall, and other hazards, are published[14]. The following damage descriptions are for events where loss information is available.

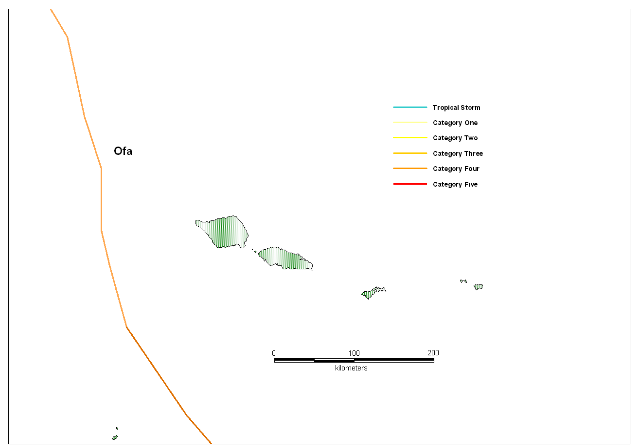
Tropical Storm Gina 1989

3.6.1. Gina developed as a tropical depression on the 6th of January 1989 around 70 kilometers south of Western Samoa. Maximum wind speeds reached around 145 kilometers. The storm is estimated to have caused USD 5 million worth of damage to roads and bridges although the damage was caused by the prolonged period of heavy rain which resulted in floods and landslides.

Cyclone Ofa 1990

3.6.2. Cyclone Ofa intensified into a tropical cyclone 720 kilometers north west of Samoa on the 1st of February. The storm then travelled south east intensifying to a category 3 cyclone on the 2nd of February and to a category four cyclone on the 4th of February. Its closest position to the Samoan coastline was 118 kilometers at which it had reached windspeeds of 203 km/hr. The central pressure of the cyclone was 986 mb and there was an associated storm surge of 1.6m.The cyclone remained at that distance and intensity for 3 days travelling in a south south-eastern direction. Cyclone Ofa caused extensive damage along the northern coasts of both Upolu and Savaii. After the cyclone, the frequency of occurrence of the maximum recorded wind gust speeds of 130 km/hr was calculated as once every 24 years by R Carter working on behalf of SOPAC.

Figure 3.6: Cyclone Ofa track.



A survey of the damage in Upolu was completed by SOPAC in April 1990[15]. The section on agriculture is not detailed and refers only to uprooting of coconut trees, saltwater damage to trees and depositions of coral debris from inundation of the sea.

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[14] Young, W.J. 2007. Climate Risk Profile for Samoa. Samoa Meteorological Division

[15] Rearic, Douglas. 1990, "Survey of Cyclone Ofa Damage to the northern coast of Upolu, Western Samoa." SOPAC Technical Report: 104.

Damage reports were recorded by the United Nations Disaster Relief Organisation (UNDRO). These recorded close to 100% losses to breadfruit, banana and taro, 90% damage to tree crops and 10% of coconuts damaged. Food supplies for the majority of the population for a 3 month period were required. The total damage from the event was estimated by the National Disaster Council in a preliminary report as USD 137 million, of which 27% was to primary industry including agriculture.
The Central Bank of Samoa's annual report and June 1991 quarterly bulletin showed that agricultural production was reported to have fallen by 22.3%, and with exports falling 30%.

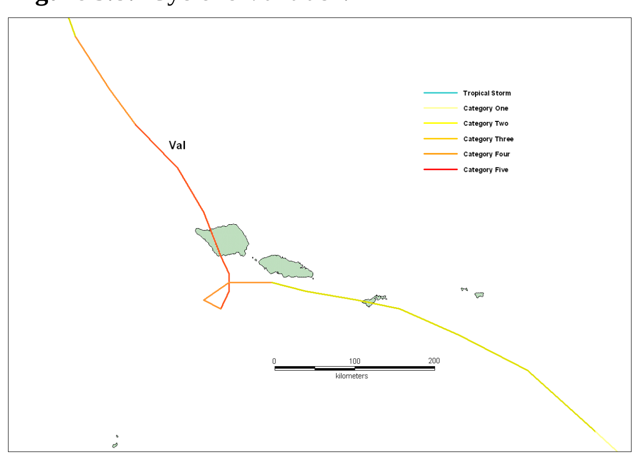
Figure 3.7: Area near the coastline at Lautuanuu village after cyclone Ofa, showing salt spray damage to coconuts. Some coastal coconut trees were uprooted and washed out to sea.

Cyclone Val 1991

3.6.3. Cyclone Val, which struck Samoa on December 6th 1991 is the most devastating cyclone event in recent Samoan history. The eye of the cyclone crossed Savaii, but the slow moving nature of the cyclone meant that Samoa was affected for 5 days. Cyclone Val originated as a tropical storm 940 kilometers north east of Samoa on the 4th of December. The storm intensified as it neared Samoa so that it was a category 4 storm when it travelled across Savaii on the 6th of December. On the 9th of December the storm lost some speed and was downgraded to a category 3 although winds remained strong at 204 km/hr. The windspeed then dropped to 176 km/hr on the 12th when it was downgraded to a category 2 storm. Cyclone Val remained within 20 kilometers of the coast for 4 days. Winds reportedly reached 240 km/hr and were followed by severe flooding. All crops were severely damaged and almost all houses on both Savaii and Upolu were damaged. Reports of damage were recorded by the United Nations Disaster Relief Organisation (UNDRO). These stated that 90% of vegetation was stripped of leaves and that 60% of the native forest was badly damaged. 47% of plantation trees were snapped or uprooted.

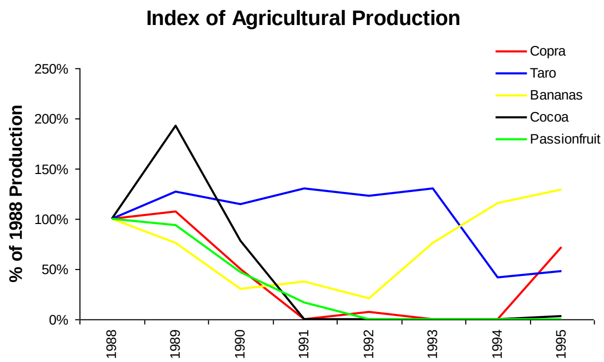
All exports of taro were stopped and diverted to domestic consumption. Mature but damaged taro was purchased and salvaged using a UNDP emergency contribution while immature taro was expected to recover and be able to be harvested after 3 to 4 months. Damage to bananas and breadfruit was estimated at over 90%. Of commercial crops, cocoa was most severely affected. Food supplements were required for a period of 6 to 8 months by which time the supply of locally grown produce had recovered. Damage to the commercial crops of coconuts ands cocoa affected exports, processing activity and employment.

Figure 3.8: Cyclone Val track.



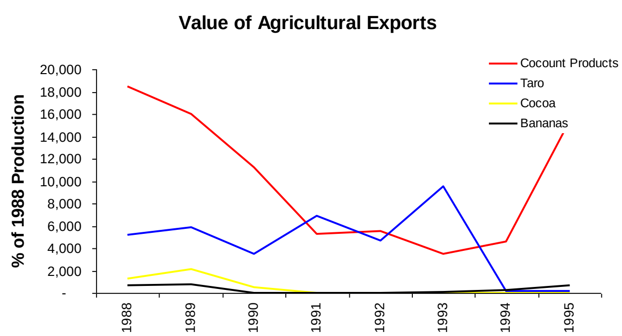
Agricultural production was estimated to have fallen by a further 13%, following the already substantial loss of production after cyclone Ofa. The effect on the production of various crops is shown in figure 3.9. Copra production halved following cyclone Ofa and then fell to zero after cyclone Val, where it remained for 4 years until 1995. Cocoa production also fell to zero after cyclone Val and did not recover. Production of Taro (and most likely other root crops such as Giant Taro or Ta'amu, Yams and Cassava), which is quick to recover from cyclone damage, was not affected substantially. Banana production halved in 1990 and did not recover fully until 1994.

Figure 3.9: Changes in agricultural production, with 1988 set as a base index of 100.



Between 1988 and 1992, the contribution of agriculture to GDP fell from 38% to 30%. In contrast, prior to the cyclones, from 1982 to 1989, the agricultural sector achieved a growth rate of 2.3% per annum.

Figure 3.10: Value of agricultural exports 1988 to 1995. Coconut products includes coconut cream, coconut oil, copra and copra meal.



There was a considerable flow on effect from the loss of raw agricultural product, as the Samoan economy is also dependent on processed products such as coconut oil, coconut cream and cocoa. Up to 90% of all export earnings at the time originated from agriculture. Following the cyclones coconut oil and copra production ceased altogether and the production of coconut cream continued only following the importation of coconuts from Tonga. The value of agricultural exports fell from WST 29.2 million in 1989 to WST 20.5 million in 1990, WST15.5 million in 1991 and WST 14.3 million in 1992.

Government assessed the total direct damage at approximately USD 300 million. The agricultural component of this direct damage was assessed as USD 80 million, with USD 18 million damage to food crops and USD 12 million damage to tree crops[16].

Cyclone Lin 1993

3.6.4. Cyclone Lin was categorised as a tropical storm when it crossed Savaii and Upolu on the 31st of January 1993. Whilst it was travelling across Upolu winds reached 100 km/hr. The storm was upgraded to a category 1 cyclone when it was 70 kilometers from the south eastern coast of Upolu at this stage the windspeed exceeded 120km/hr. Cyclone Lin caused modest damage to infrastructure and buildings but was reported to have caused extensive damage to banana production.

[16] Fairbairn, Te'o, I, J. 1997. "The Economic Impact of Natural Disasters in the South Pacific" SOPAC Technical Report.

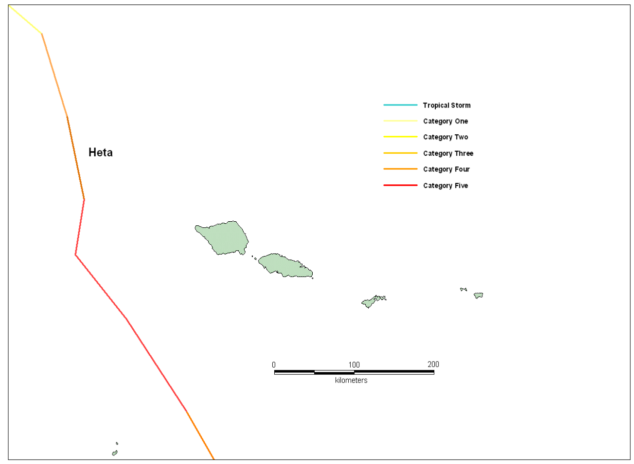
Cyclone Tui 1998

3.6.5. Cyclone Tui began as a tropical storm 417 kilometers northwest of Apia on the 25th of January 1998 crossing over the eastern Savaii on the 26th of January. The maximum wind gust in Savaii was recorded as 111km/hr. Reports about damage from this cyclone are sketchy but one life was lost, power and communications were disrupted and some crops were destroyed.

Cyclone Heta 2004

3.6.6. Cyclone Heta originated as a tropical storm 640 kilometers north of Samoa intensifying as it travelled south to a category 5 storm when it was just 140 kilometers off the coast and windspeeds reached 259 km/hr. The storm stayed at that intensity and distance for 2 days reducing in speed as it travelled south east. Cyclone Heta caused severe damage to Nuie and Tonga, and also passed close to Samoa. According to a World Bank report, cyclone Heta caused overall damage valued at US 25 million, including losses to trees, crops and coastal infrastructure [17]. Seawalls constructed after cyclones Val and Ofa were reported to have reduced the extent of the damage.

Figure 3.11: Cyclone Heta track.



Cyclone Olaf 2005

3.6.7. Cyclone Olaf came within 125 kilometers of the north coast of Samoa with maximum windspeeds of 269 km/hr when it was 130 kilometers north of Savaii. The cyclone remained as a category 4 to 5 cyclone for 5 days. The damage from cyclone Olaf was minor compared to previous cyclones with the principal National Disaster Officer in Samoa, Mena Nelson, describing it as "almost a non-event" and with not much evidence of damage, being limited to "only a few bananas, fallen bananas, fallen trees here and there but nothing substantial. No damaged houses, just a few power lines in Savaii, but it's back to normal now".

Conclusion – Tropical Cyclone

3.7. There have been three tropical cyclones in the last 66 years which have caused significant damage to Samoan agriculture and infrastructure. Generally cyclones of category two or three coming close to the coastline or making landfall are sufficient to cause significant economic damage. The actual frequency of one severely damaging cyclone every 22 years is consistent with the modelled frequency for Apia of a category 2 cyclone every 13 years or a category 3 cyclone every 35 years.

The cost of the damage caused to agriculture by tropical cyclones has not been measured accurately, and it is difficult to do so. The total cost comprises not only the direct cost of damage to current and future production, but also the loss of income from processed products and the destabilisation or loss of export markets. However, reported losses are for direct damage only, and include all sectors including agriculture in table 3.4.

[17] Fossberg, Melissa. 2004. "Samoa: Cyclone Heta's damages to be addressed." World Bank. Washington, DC.

Table 3.4				
Value of Cyclone Losses				
Event	**Year**	**Total Losses (USD m)**	**GDP (USD m)**	**Losses (% of GDP)**
Cyclone Ofa	1990	137	112	122
Cyclone Val	1991	300	112	268
Cyclone Heta	2004	25	358	7

In the 66 years since 1945, three major cyclones have caused aggregate damage valued at 397% of GDP. This equates to an annual damage cost of 6% of GDP, which based on the 2009 GDP of US496 million is equivalent to US 30 million per annum. This figure is understated as it does not include losses from minor to moderate events, for which there is no accurate historical loss data. Neither does it include the consequential losses associated with the direct damage caused, which for agriculture can be very substantial as witnessed by the reduction in agricultural production and agriculture's share of GDP which lasted for several years after cyclones Ofa and Val.

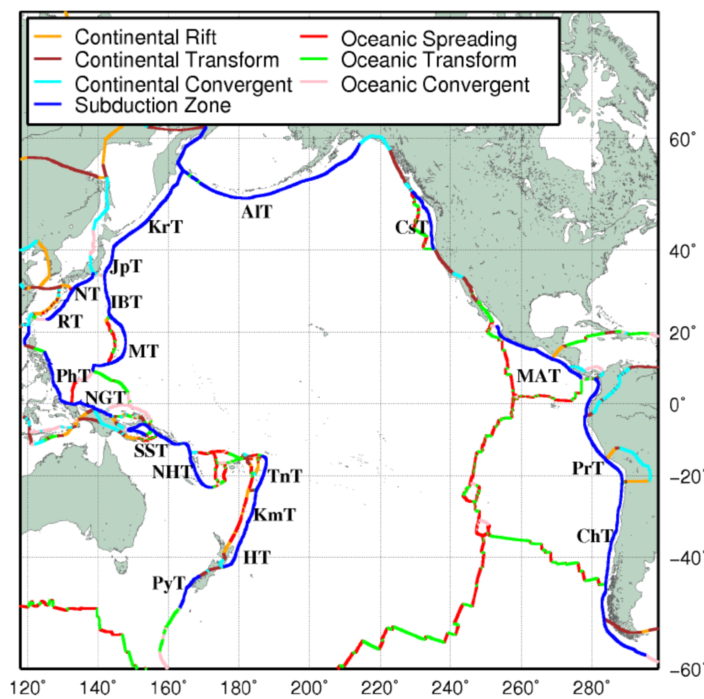
Agricultural losses form an important but uncertain component of the average annual loss amount. Agricultural losses represented 27% of the total direct damage losses in Cyclone Val but the flow on effects for agriculture were much greater and longstanding.

Tsunami

Background

3.8. Tsunamis are most often generated by earthquakes occurring in the ocean, but can also be generated from undersea landslides or undersea volcanic eruptions. The risk of tsunami is most directly related to the likelihood of strong earthquakes occurring in places separated from Samoa only by the ocean. Over 80% of earthquakes occur in the ocean, mostly at the boundary of tectonic plates (called subduction zones), and those with sufficient magnitude to raise the seafloor can lead to tsunamis. There are major subduction zones to the west, north and east of Samoa as shown in figure 3.12. The South Pacific is one of the world's most active seismic regions, with the junction of four major tectonic plates – the Sundra plate, Philippine sea plate, Pacific plate and Australia plate. The most important source of a tsunami damaging Samoa is considered by Geoscience Australia to be an earthquake near Tonga. However there is also a risk of tsunamis from more distant earthquakes.

Figure 3.12: Subduction zones In the Pacific (shown in blue) create a tsunami hazard from the east, north and west of Samoa. Source: Geoscience Australia : A Preliminary Study into the Tsunami Hazard faced by *South West Pacific Nations* 22nd June 2007



Samoa lies at the northern end of a belt of earthquake activity that runs in an approximately north-south direction at the juncture of the Pacific and Australian tectonic plates (figure 3.13).

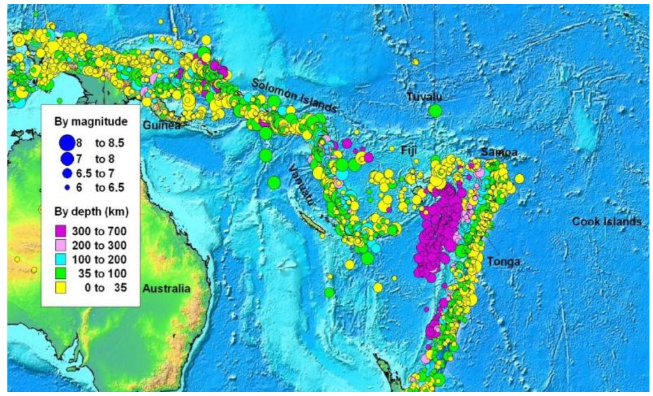


Figure 3.13: Epicentres of earthquakes with a magnitude greater than or equal to 6, between 1900 and 2007. S*ource: World Bank Pacific Risk Financing Initiative September 2008*

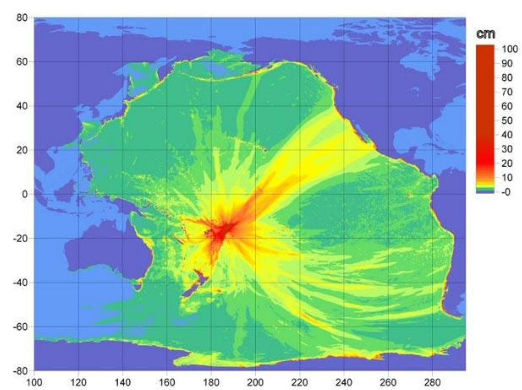
History of Tsunamis

3.9. Severe tsunamis have a low frequency of occurrence meaning that there is limited actual experience of tsunami damage. Damaging tsunamis occur roughly once a year somewhere in the world. The NOAA National Geophysical Centre tsunami database records tsunamis from 1990 onwards. In the Pacific region there have been 5 tsunamis causing one or more deaths since 1900, two in Samoa, one in Fiji and two in New Zealand. Of these events wave heights ranged from 2.5 meters in 1929 in New Zealand up to 16.3 meters in Samoa in 2009. All tsunamis were the result of earthquakes ranging from 6.8 to 8 on the Richter scale. Note that events earlier in the 20th century may have caused deaths but this information may not have been recorded. According to the NOAA tsunami database, Samoa has experienced 15 tsunami events in total since 1900 although only 4 have generated significant waves. Apart from the 2009 event, earthquakes in 1907, 1915 and 1917 generated waves of 3.6, 2.4, and 12.2 meters respectively. This information is confirmed in a report produced by the International Tsunami Information Centre in 1980 which details all known Samoan tsunami events[18].

2009 Samoan Tsunami

3.9.1. Samoa, along with Tonga and American Samoa was hit by a powerful tsunami on 30th September 2009, resulting in at least 192 deaths. The tsunami was caused by a magnitude 8.0 earthquake with an epicentre only 196 kilometres from Apia and which caused a movement in the seafloor of up to 7 metres with a 200 to 300km rupture. Twenty villages were destroyed in Samoa, mostly on the east and south coast of Upolu. While there was severe damage in some coastal areas, the impact on agriculture was much lower than for a severe tropical cyclone, as the geographic extent of damage was comparatively limited.

Figure 3.14: September 2009 tsunami wave propagation map. Source: *NOAA*



The loss to agriculture (excluding livestock and fisheries) from the event was estimated as WST 9.62 million (USD 3.63 million)[19]. The assessment differentiated between direct damage and losses, with losses including the consequential losses associated with business interruption (loss of income to farmers until they are back in production). Direct damage was assessed as WST 1,53 million (USD 578,000) and consequential losses as a further WST8.09 million (USD 3.05 million).

This report also specified early recovery needs for agriculture for a total amount of WST 8.54 million (USD 3.2 million). The calculation of this figure was based on the cost of material items necessary for

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[18] George, Pararas-Carayannis. 1980. “Catalog of Tsunamis in the Samoan Island”. International Tsunami Information Center, Honolulu, Hawaii.

[19] Agriculture and Fisheries Sector. 2009. “Report of Tsunami in Samoa.”

the recovery process, such as machinery, hand tools and seeds. The calculation of the value of some of these items was significantly overstated – for example 10 chainsaws at USD 11,300 each.

Modelling Tsunamis

3.10. AIR Worldwide also developed a risk assessment model for 8 Pacific Islands, including Samoa, for tsunamis generated by earthquakes. As with tropical cyclones, a database of simulated earthquakes can be developed based on the earthquakes that have actually occurred. The model includes only the largest earthquakes, of magnitude 8.5 or more. For each of the modelled earthquakes, the tsunami model adds information about undersea slips at the interface between tectonic plates and the characteristics of the seafloor (bathymetry). This information can then be used to model peak wave heights at the coastline.

The risk of tsunami loss in Samoa was considered to be lower than for the other 7 pacific Islands studied (Fiji, Papua New Guinea, Solomon Islands, Tonga, Vanuatu, Cook Islands and Tuvalu) with a calculated loss of less than USD 5 million once every one thousand years. Of particular relevance in Samoa is that the vulnerability is quite restricted to a narrow coastal belt, due to the marked topography of the main islands. Whilst the coastal belt is densely inhabited, much of the agricultural production is located at higher altitudes than the coastal plains. This explains the relatively low loss of agricultural assets resulting from the 2009 tsunami. Further, production is being relocated further inland from some areas affected in 2009.

Similar modelling has been conducted by Geoscience Australia for 18 Pacific nations[20]. This modelling focused on determining the highest amplitude offshore tsunami (which roughly corresponds to expected tsunami height at the coastline) from databases of firstly, 187 earthquakes of magnitude 8.5 and secondly 39 earthquakes of magnitude 9.0. Samoa ranked as experiencing the sixth highest amplitude tsunami for both scenarios, with Solomon Islands, Tonga, Vanuatu, Papua New Guinea and Guam likely to experience larger tsunamis. The study did not look into the frequency of tsunamis.

Conclusion – Tsunami

3.11. While potentially devastating to coastal communities when they occur, tsunamis are considered to be of comparatively low risk to agricultural production, due to their actual and predicted infrequent occurrence compared to other perils such as tropical cyclone and pest and disease outbreak, and the relatively limited area of geographical exposure, in comparison to other hazards such as cyclone.

Pest and Disease Outbreaks

Background

3.12. Samoa has been affected by several significant outbreaks of pests and diseases which have impacted on production. A relatively narrow range of crops are grown in Samoa, even fewer of which have a commercial significance. This makes the sector more vulnerable to pest and disease losses. The stand out event was the introduction of taro leaf blight in 1993 which devastated the industry and had a substantial impact on the national economy.

[20] Thomas, Christopher, Burbidge, David, and Cummins, Phil. 2007. "A Preliminary Study into the Tsunami Hazard faced by Southwest Pacific Nations." Risk Impact Analysis Group, Geoscience Australia.

History of Pest and Disease Outbreaks

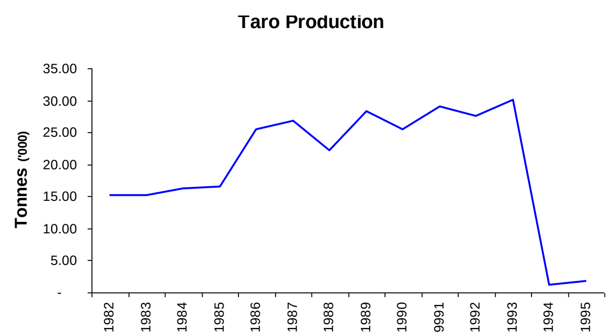
Taro Blight 1993

3.13.1 The most severe pest or disease outbreak to affect Samoa was the taro leaf blight outbreak of 1993. Taro leaf blight is a fungal disease which infects the leaves of taro plants. Infected leaves develop small circular lesions which enlarge over a period of days, reducing the lifespan of the leaf from 40 days to 10-20 days. Infected plants may be reduced to 1-3 functional leaves compared to 6-7 on a healthy plant. As a result there is a reduction in yield of 30 to 50%, and the fungus may also cause rots in harvested corms.

The disease spreads in water splash from plant to plant, and by human transportation of infected plant material over longer distances. The fungus can also survive on planting material.

Taro leaf blight was first detected in American Samoa in June 1993. In less than a month the disease was confirmed in Samoa, in several districts of Upolu. Taro leaf blight spread throughout the country rapidly, it is suspected through the transportation of infected planting material. Major replanting was still occurring in the wake of cyclone Val, and with many other permanent crop types destroyed, taro was the mainstay of agricultural production. The most susceptible variety, Nuie, was vastly predominant and created what was effectively a monoculture.

Figure 3.15: Taro production 1982 to 1995[13]



The disease came close to wiping out taro production altogether, with 95% of the taro plantations destroyed [21]. At the time taro generated over half of Samoa's export revenue. The value of taro exports fell from WST9.5 million in 1993 to WST158,000 in 1994 and has still not recovered (figure 3.15). While Samoa was out of production, neighbouring Fiji capitalised and replaced Samoa as the major exporter or Taro to New Zealand, Australia and the United States.

Many countries produce taro despite taro leaf blight being endemic. There are several forms of control: through management practices (leaf removal, crop rotations, plant spacings), application of fungicides and most importantly, planting varieties resistant to taro leaf blight.

Papaya 2008

3.13.2. Papaya is the most consumed fruit in Samoa and has also been identified as an export opportunity by the fruit and vegetable sector. Nevertheless, the export of papaya from Samoa in 2010 has ceased, as sufficient volumes have not been able to be sourced. The reason for the decline is at least partly due to the spread of a fungal root disease resulting in the loss of the majority of trees[22]. The disease outbreak was in turn linked to the importation of infected seeds from Asia. A poor payment history from exporters to farmers is another factor, and it is difficult to determine the relative importance of each in the demise of the small but developing export industry.

[21] Hunter, Danny, Pouono, Kirifi, and Semisi, Semisi. 1998. "The impact of taro leaf blight in the Pacific Ilsands with special reference to Samoa." Journal of South Pacific Agriculture 5:44-56.

[22] Tamasese, Edwin. 2009. "An Analytical Study of Selected Fruit and Vegetable Value Chains in Samoa." United Nations AAACP Paper Series: 11.

Pest and Disease Outbreaks: Conclusion

3.14. While pest and disease outbreaks can cause substantial industry losses, the extent of these is determined to a large degree by the efficacy of prevention measures (and notably quarantine regulations), the ability to detect any new outbreak, the speed and effectiveness of any control measures, and the adoption of appropriate farm management practices should a new pest or disease take hold. The ability for human intervention to prevent and control pest and disease outbreaks places them into a different category than weather events such as tropical cyclone.

Other Events

3.15. Some other events, notably flooding, excessive rainfall and drought, were cited as having caused or having the potential to cause losses to agricultural crops, which are grown under rainfed conditions. While this may be the case, the frequency and severity of these events is not considered to be of the same magnitude as for tropical cyclone, tsunami or pest and disease outbreaks. Farming practices are adapted to seasonal conditions.

Localised flooding occurs frequently, often in conjunction with tropical depressions, storms or cyclones. Flooding of rivers (and notably the Vaisigano River whose catchment flows out through Apia) occurs in most years during the wet season between November and April. Floods have occurred in Apia in 1939, 1974, 1990, 2001 and 2006. There was also flooding in conjunction with cyclones Gina (1989), Ofa (1990) and Val (1991). While the damage to buildings and infrastructure has been serious (in 2001, 1300 buildings were damaged and 28,000 had water supplies cut), agricultural production has not been dramatically affected.

While drought is a potential problem, with some reported losses for example in 2009 and 1998, water in Samoa is generally plentiful with an annual average rainfall in Apia of over 2500 mm, and other locations receiving rainfall in the range of approximately 1700mmm to close to 5000mm. When dry conditions occur, there is generally water available for farmers to irrigate their plants. Otherwise, irrigation is not currently normal practice in Samoan agriculture.

Other Events Conclusion

3.16. Other events are not considered to be sufficiently damaging to be considered further in this study.

Constraints to agricultural production

Production Methods and level of technology

3.17. Farmers in Samoa generally operate on a subsistence basis and market any surplus produce. There is a low adoption of technology, and yields could easily be improved if principles of variety selection, irrigation, pest, disease and weed control and cultivation were followed. In this regard Samoan farmers have limited access to qualified extension officers to disseminate information and support education in farm management practices. The Ministry of Agriculture employs 6 extension officers, while some other organisations also make extension services available – for example Women in Business and the Farmers Association.

The prevalence of subsistence farming also means that supply of produce and its quality is erratic, limiting the scope to meet the fruit and vegetable supply requirements of potentially lucrative markets such as hotels and restaurants.

Access to input supplies

3.18. It is reported that input supplies (seeds, fertilisers) are not well co-ordinated in terms of type and quality, in relation to the needs of farmers and of the crop calendar. Whilst this might reflect the lack of commercialisation of F&V crops and lack of co-ordinated demand, it can be considered a constraint to development of the sector. In particular, improved seeds and planting material are needed for commercial production, and potentially for reasons of climate adaptation.

Access to Markets

3.19. There is a limited local market for fruit and vegetables in Samoa. Local consumption of fruit and vegetables reportedly lags behind World Health Organisation minimum requirements[23] although this calculation is dependent on knowing the total fruit and vegetable production in Samoa, a figure which is uncertain at best.

There is the potential for the replacement of imported fruits and vegetables, but currently this is hindered by problems with consistency in supply volumes and quality.

The same issues confront the supply of export markets, with the additional complication of meeting the quarantine requirements of importing countries and absorbing the cost of freight. There is currently some export of taro, limes, bananas, noni and coconut products. There are opportunities to export fruit and vegetable products to New Zealand and Australia to meet the demands of the expatriate Samoan community, but this would be in competition to existing supplies from Fiji and the Philippines.

Access to Finance

3.20. The main financier of agriculture in Samoa is the Development Bank of Samoa (DBS). For the year ended 30th June 2009, the bank had a total loan portfolio of WST 70.33 million of which 25% or WST 17.66 million were agricultural loans, with an average value of around WST 7,500 each. There are provisions within the loan portfolio for bad loans of WST 7.82 million or 11.1%. The rate of lending to agriculture has been declining (down from 33% of the portfolio in 2008), and the bank attributes this to a decline in the export sector and a growing emphasis on industry. While access to finance may impose some constraint on certain agricultural projects, this is not considered as important as some of the other constraints. Although it is impossible to accurately judge the extent of unsatisfied demand for loans, given the size of the SDB loan portfolio there is a significant amount of funding available.

Land Tenure

3.21. Most land in Samoa (81%) falls under customary title. This land cannot be made freehold, fall under foreign ownership, or be encumbered by borrowings. It is, however, possible to lease customary land and there is a trend towards individuals taking custodianship of areas of land they clear. While often cited as such, the availability of land and the ownership structure may not be a significant impediment to agricultural production. There is government, Samoa Land Corporation and Samoan Trust Estates Corporation owned land potentially available for agriculture.

[23] Hanemann, Patrick. 2010. “Strengthening the Performance of Samoa’s Fruit and Vegetable Sector”. World Bank. Washington, DC. Processed.

Soils

3.23. Soils in Samoa are riddled with volcanic rocks, some of which are very large. The rocks are an impediment to cultivation and to the production of some root crops and investment is required to clear the land.

Exposures and Vulnerability

3.24. Most Samoan households conduct a mixture of subsistence farming and cash cropping. Generally a mixture of several crops is grown – typically taro, coconuts, breadfruit and bananas. At the time of the 1999 Agricultural census there were 114,763 acres under crops and 14,725 agriculturally active households, giving an area per agricultural household of 1 acre (0.4 hectares).

3.25 Land use capability is dominated by contour and soil type. Close to the coast, and for varying distances inland, is predominantly a canopy of coconuts, with taro and bananas occasionally grown beneath. Soils in this area are relatively depleted. Further inland is the main production zone with many crops grown. The area further inland still has previously been used for taro production, but since the outbreak of taro blight has often reverted to the forest which dominates the steeper central areas.

Exposures

3.26. There is only a limited ability to map the agricultural exposures (assets at risk) in Samoa. The main reasons for this are firstly, that there is no registration system for farmers and with a high adoption

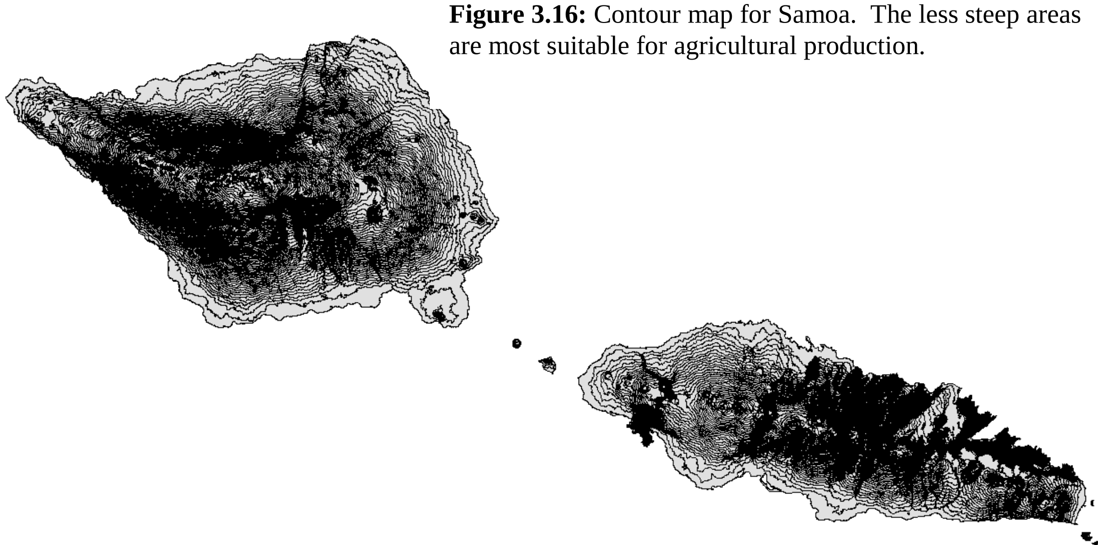


Figure 3.16: Contour map for Samoa. The less steep areas are most suitable for agricultural production.

of subsistence farming it is difficult to determine what rightly constitutes a "farm". Secondly, the most recent mapping of Samoa was an aerial survey completed in 1999, and the GIS map layers subsequently developed use this as the base data. It may be possible to develop a more recent land use map, utilising satellite imagery, but as far as we can ascertain this has not yet been done.

Options that were pursued for mapping the location of agricultural exposures included:

- A land use map developed by FAO in 2004, based on the 1999 aerial photographs. FAO identified areas planted to various different categories of agricultural land use, although the focus of the project was forestry.
- The value of loans made by the Samoan Development Bank, by district.

- The percentage of income derived from agriculture of farmers per district, according to the last agricultural census which was completed in 1999 (the results of the 2009 agricultural census are due to be released later in 2010).

FAO Land Use Map

3.27. The land use map developed by FAO in 2004 is shown in figure 3.18. These files, while developed in GIS mapping software Mapinfo, were only able to be provided in PDF format. Utilising Mapinfo format it would have been possible to calculate the planted area in hectares of each category of land use and thereby assess total values per category. The land use maps show cropping activities concentrated in the northwest of Upolu and north of Savaii. Coconuts grow in most coastal areas of both islands.

Value of Loans

3.28 The value of agricultural loans per political district was requested from the Samoan Development Bank. They were only able to provide the value of loans for 3 separate areas - East and West Upolu and Savaii, which did not allow the assessment of loan portfolio and it not pursued further here,

Percentage of Income of Farmers

3.29 Table 26 of the 1999 agricultural census shows the number of households deriving none, about one quarter, about one half, about three quarters and all of their income from agriculture. From these figures a weighted total of the number of households deriving their income from agriculture was calculated. The results are shown in figure 3.17.

Figure 3.17: Equivalent number of households deriving all of their income from agriculture, as per the 1999 Agricultural Census

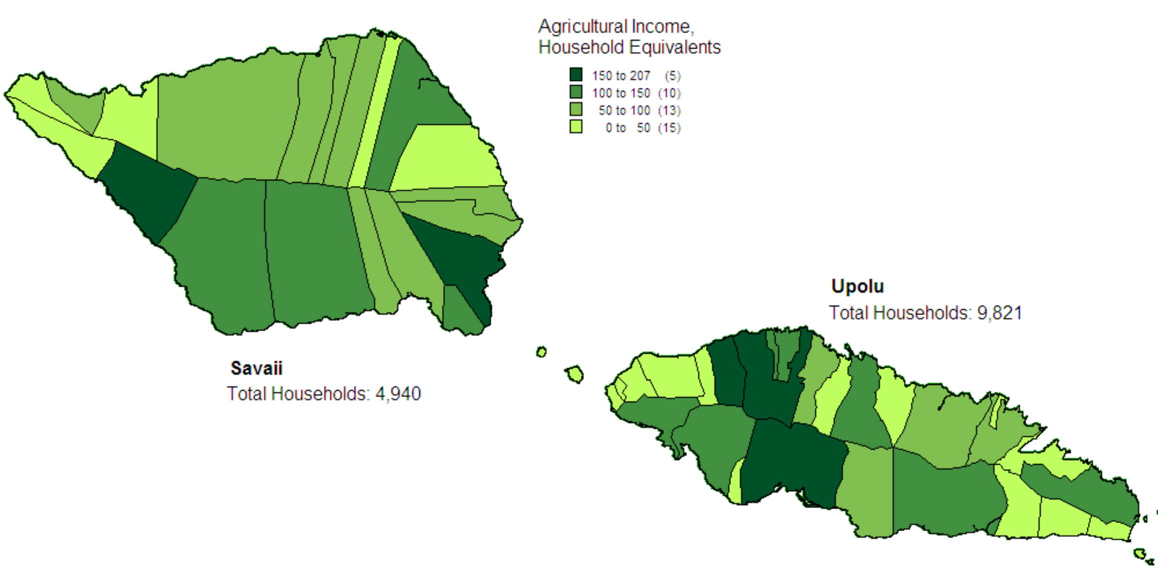
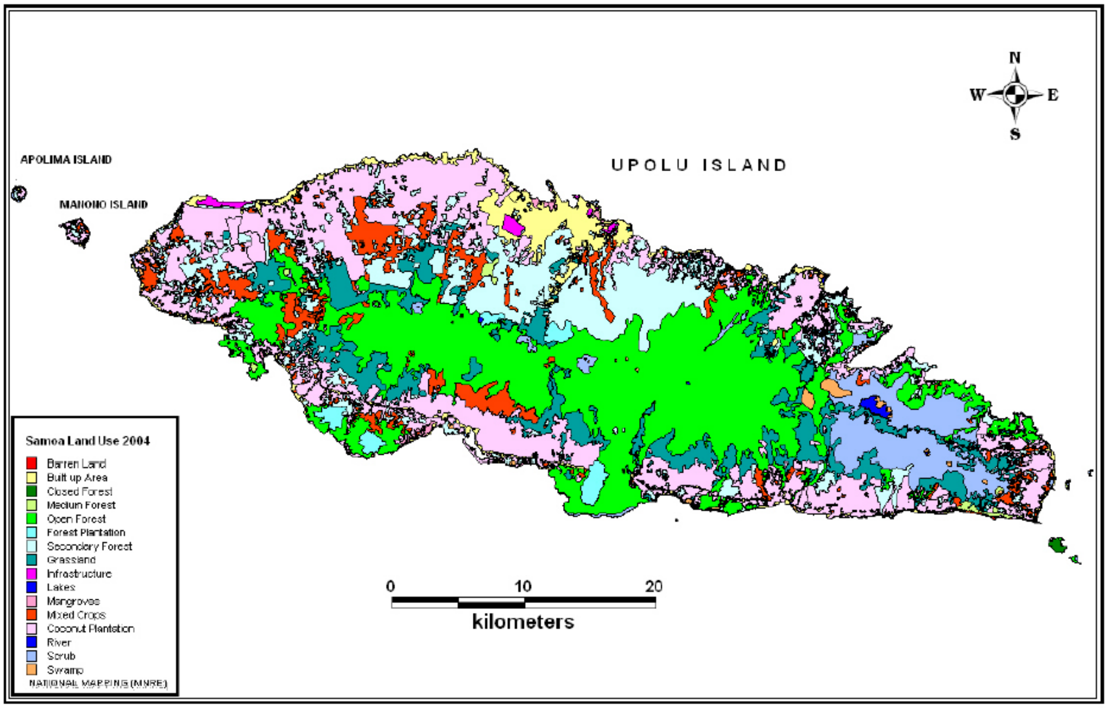
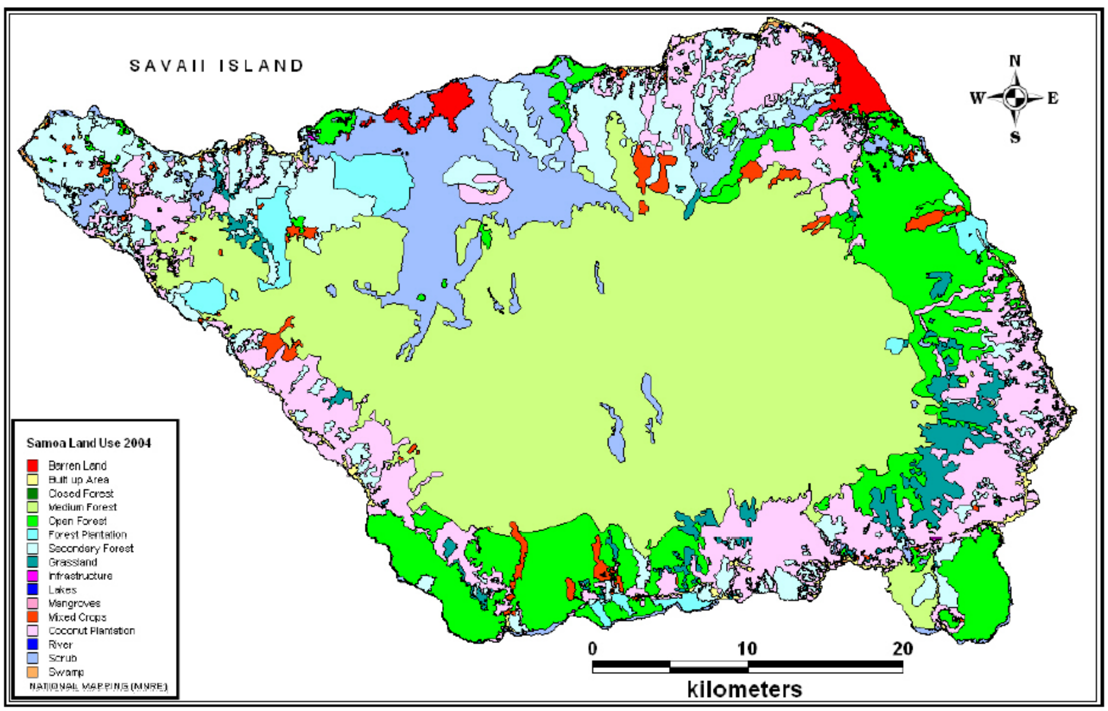


Figure 3.18: Landuse map for Upolo (top) and Savaii (bottom). Mixed crops are shown in red and cocount plantations in pink. *Source: Department of Natural Resources and Environment.*

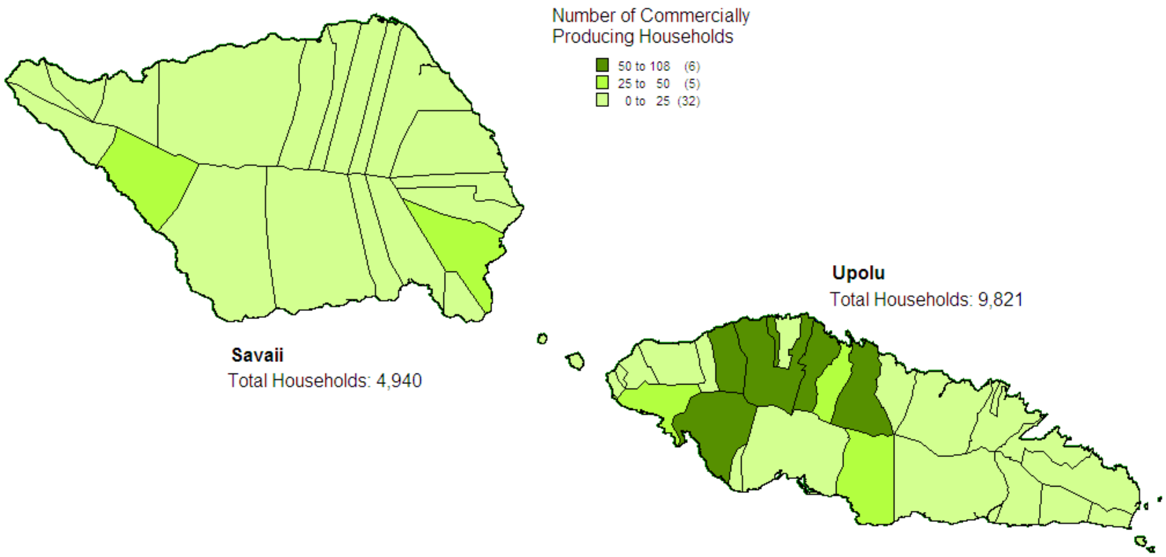




Commercial Farmers

3.30. There are very few commercial farmers in Samoa. Figure 3.19 shows the number of households deriving all of their income from agriculture, as per the 1999 Agricultural Census. Commercial activity is concentrated around northern and western Upolu.

Figure 3.19: Number of households deriving all of their income from agriculture (commercial farming)



Vulnerability

3.31. The vulnerability of the specific crop types grown in Samoa, to the range of perils they can potentially experience, has never been formally studied. In fact internationally, there are very few crop-peril combinations which have been studied in sufficient detail to develop a formal damage function (a damage function shows the expected percentage loss for different intensities of the peril concerned, as an input into crop hazard models as practiced for property risks). However the vulnerability of various crops to major perils is quite well understood based on experience in other countries and on the recorded experience in Samoa.

Two other relevant factors are the ability and timescale for crops to recover from damage, and the value of crops per planted area. Table 3.5 lists the six most important crops in Samoa, their vulnerability to cyclone damage, ability and time to recover, and revenue derived per hectare.

Table 3.5
Crop Vulnerability

Crop	**Susceptibility to cyclone damage**	**Recovery Potential**[1]	**Value per hectare**
Coconut	Low	Low	Low
Local market vegetables	High	High	High
Taro and Giant Taro	Medium	High	Medium
Breadfruit	Medium	Medium	Medium
Banana	High	Low	High
Papaya	High	Low	High

[1] length of time to return to production.

Coconut trees themselves are comparatively resistant to wind and cyclone damage, although if the nuts are blown off the tree it takes a long time for replacements to develop with a period of 12 to 14 months between flowering and harvest. If trees are uprooted or snap in severe storms, replacement trees will take 6 to 7 years to bear a crop and do not reach maximum production until aged 25.

Local market fruit and vegetables are easily destroyed by cyclone, but generally have a 3 to 4 month cropping cycle and are therefore readily re-established.

The leaves of taro and giant taro are easily damaged by strong winds but the corm underground is almost completely resistant. Following damage mature taro can be harvested, although this needs to be done quickly before the corm rots. Young taro will often recover, developing new leaves and growing through to harvest. If taro plants are replaced, they will mature in 6 to 9 months.

Breadfruit trees themselves are moderately resistant to cyclone damage, and trees will grow back after being damaged. Breadfruit typically produces two crops each year, thus production is lost for a period of at least 6 months. If trees are replaced, they begin cropping in 3 to 5 years.

Bananas are the crop type most readily damaged by high winds or cyclones, with plants being easily uprooted or snapped due to the shallow root mat. Wind speeds as low as 40km/hr are capable of toppling plants when they are bearing fruit, especially the taller varieties. After damage, new shoots may be capable of forming from the root mat. Having cut back the main stem, the suckers on a root mat will carry matured fruit again in 9 to 10 months. If fully replanted, bananas take 12 to 15 months to crop.

Papaya trees are also relatively easily broken by strong winds or cyclones, but have the ability to regenerate from the stump. If replanted Papaya trees come into production quickly, around 5 months after planting, and trees live for 4 or 5 years.

Chapter 4: Risk Management in agriculture

Strategies for risk management

4.1. It is useful to categorise risk management strategies into "informal" (Farm household or community based) and "formal" (market based, or publically provided) (Figure 4.1). The strategies which can be followed in any given situation are also dependent on whether risks are severe (and difficult for the farmer to manage within the household or community), or less severe, in which case the household or community has more capacity to cope (Figure 4.2.)

Figure 4.1. Informal and formal risk management strategies

Informal Risk Management Strategies		
	Farm Household level (mitigating risks)	**Community-level (sharing risk)**
Ex Ante	Savings	Food crop sharing
	Buffer stocks	Common property resource management
	Enterprise diversification	Social reciprocity
	Low risk, low return cropping	Rotating savings/credit
	Production techniques	
Ex Post	Sale of assets	Sale of assets
	Reallocation of labour	Transfers from mutual support networks
	Reduced consumption	
	Borrowing from relatives	
	Remittances	
Formal Risk Management Measures		
	Market-based (share/transfer risk)	**Publically-provided (transfer/absorb risk)**
Ex Ante	Contract marketing	Pest/disease management
	Financial hedging tools (options)	Physical crop/food stocks
	Traditional insurance	Price guarantees or stabilisation funds
	Weather-index insurance	Input subsidies
	Contingent funds for diaster relief	Public insurance
Ex Post	Savings	Disaster assistance
	Credit	Social funds
		Cash transfers
		Waiver (cancellation) or crop loans

Figure 4.2. Potential risk management strategies according to severity of risk

Severity of Risk		Household/community	Markets	Government
	Non-specific	Sharecropping	New technology	Irrigation infrastructure
		Farmer self-help groups	Improved seeds	Extension
		Water resource management		Agri research
				Weather data systems
	Low	Crop diversification	Formal savings	
		Savings in livestock		
		Food buffer stocks		
	Medium	Labour diversification	Formal lending	State-sponsored lending
		Risk pooling (peers, family members)	Risk sharing (input suppliers/wholesalers)	
		Moneylenders	Contract farming	
	High	Sale of assets	Insurance	Disaster relief
		Migration		State-sponsored insurance

4.2. In Samoa, **informal risk management strategies** predominate in rural households. The traditional village structure allows for community based decisions and actions. With the exception of the major shock events of cyclone, flood or tsunami, levels of risk facing farming households may be considered relatively low, so that improvement in productivity, and management of volatility in normal crop production is largely a question of the application of good agricultural practices. Informal risk management strategies, such as savings, and preparation of plans for expected rehabilitation of agriculture are still important in coping with disasters. The extent of informal strategies within household and village level planning was not part of the present study. However it is noted that there is diversification of income sources for rural households, with only part of income derived from agriculture. Where crops and livestock are grown for self-consumption, the coping measures needed, at least for agricultural rehabilitation, may be non-monetary or monetary. For diversified, non-commercialised, rural households, a holistic approach is needed to considering measures for the household coping with major risks, of which crop and livestock is only one part.

4.3. **Formal market based risk management** is almost non existent for agricultural producers. As noted, there is no crop or livestock insurance in Samoa, although the insurance sector is developed for property and other insurance lines. There is no formal mechanism for rescheduling or interest alleviation on loans, following loss. This is primarily an issue for (a) commercial producers; and (b) producers with loans or other financial obligations. In the case of commercial farmers, investment (through their own financial resources, or loans) is needed for production until harvest. Loss of the crop, livestock or equipment (including fishing boats) gives rise to financial loss, and possible inability to re-start production. Commercial farmers are less likely to be diversified in their sources of income, and more dependent on agriculture, and more financially vulnerable. Following severe events such as Cyclone Val in 1991, The Development Bank of Samoa, with government support, forgave the interest on agricultural loans to affected farmers for a period of three years. Following cyclone Heta, there was no government relief for agricultural loans and as a result an increased rate of defaults and problem loans.

4.4. The Samoan government has promoted **formal public disaster risk management**, through the development of a Disaster Management Plan, co-ordinated through the National Disaster

Management Office (DMO), and involving all line ministries as needed. This comprehensive approach is intended to provide a safety net for disaster events which may affect large numbers of the population, and for events with which they may be unable to cope without government intervention. The government also protects government property through commercial insurance.

4.5. The DMO, which was established in 1997, is the focal point of all disaster management programmes. This includes all aspects of disaster mitigation, preparedness and response. A National Disaster Council is responsible for the oversight and approval of all disaster management activities. Disaster management is governed by a "National Disaster Management Plan 2006-2009". There are additional specific plans in relation to tropical cyclone (Tropical Cyclone Response Procedures (2000)) and invasive plant or animal species (Emergency Response Plan for Animal and Plant Pests (Nov 2005)).

4.6. A project currently being completed by the DMO that has much relevance to the agricultural sector is to collate profiles of each village. The profile includes details such as the total area of agricultural land, the major crops grown and number of people/households engaged in that activity, the seasonality of crops, and vulnerability. Currently there is no registration system for Samoan farmers and this register will help to identify what has been lost following a major loss event.

4.7. The DMO also runs a programme for community disaster awareness. This includes education about the types of hazards that may occur and the appropriate response such as evacuation routes. Nationwide trial responses for tsunami warnings have been conducted at fairly regular intervals.

Response mechanisms

4.8. When a major weather or natural disaster event occurs, the Disaster Management Plan is implemented, controlled by DMO and its committees, and responsibilities are allocated to each ministry for assessment of damage and loss in the sector falling to their responsibility, and the drafting of recovery and reconstruction plans. As per internationally accepted practice, Samoa adopts damage and loss assessment methods developed the UN Economic Commission for Latin America and the Caribbean (ECLAC). This was most recently implemented following the tsunami in 2009[24]. The government was supported in the assessment by a wide range of organisations (UN ESCAP, World Bank, ADB, UN-ISDR, NGO's and individuals).

4.9. Following an event loss assessment activities for the agricultural sector are conducted by the Ministry of Agriculture. They utilise their own staff, and if numbers are insufficient to cope, reputable local residents. Following the 2009 tsunami assessments relied on information such as the 1999 census of agriculture, and local knowledge, to try to determine what crops had existed prior to the event and the level of appropriate in-kind response to support recovery. Distributions to farmers were of a selection of handtools with a maximum of 2 items given to a household and a total number of approximately 1000, as well as small packets of seeds.

4.10. Aid donations are made to the Samoan government, who is then responsible for their distribution. There is an inflow of disaster aid funding and equipment from governments and donor organisations. There are numerous contributors but predominant ones have included the New Zealand, Australian and United States Governments, Oxfam, the Red Cross, FAO, the World Food Programme (WFP) and the United Nations. In general terms the level of assistance provided to Samoa following disasters is impressive.

4.11. Remittances from Samoans living abroad are a major source of revenue. Remittances normally amount to around 24% of GDP (WST 366 million in 2008-09), but increase significantly after a major catastrophe to form a major complement to any formal disaster relief programme.

[24] Samoa: Post Disaster Needs Assessment following the earthquake and Tsunami of 29th September 2009. Government of Samoa/World Bank/GFDRR report, December 2009.

On farm risk management

4.12. The perils which affect agriculture can be mitigated to varying degrees by management.

4.13. **Tropical cyclone**, which is the major peril facing agriculture, is largely unmanageable. Farmers can grow a mix of crops to ensure that they do not have a total dependence on the most susceptible crop types such as bananas and papayas. For some species, such as banana and coconut, there are more wind tolerant varieties that can be selected (eg: short, sturdy and well rooted banana varieties; in some countries dwarf coconut varieties are used). Following a cyclone farmers need to harvest damage crops quickly, and store or distribute them. The lifespan of harvested taro can be extended by storing underground. Giant Taro (Taamu) has the ability to be stored underground for two to three years[25]

4.14. Any impact of **drought** can be substantially reduced through the introduction of irrigation systems or manual watering. Drip irrigation is not used to any extent in Samoa. The orientation of plantings can also help relieve the risk of water stress, with planting lines following contours and backed by small ridges which will trap surface runoff water. Selection of the most appropriate varieties is also important.

4.15. The **excessive rainfall risk** can be reduced by planting crops in traditional growing seasons, or by using plastic tunnels. Plastic tunnels allow crops to be grown outside the normal season, thereby supplying markets at times of higher market price.

4.16. **Pest and disease** outbreaks are a risk but can be controlled by management. The risk can be mitigated through border security and quarantine procedures, varietal selection, and control measures such as the application of pesticides and fungicides.

4.17. There are no practical on farm risk management procedures against tsunami, except long term relocation of growing areas to higher ground.

Price risk management

4.18. Farmers sell in the fresh market, with supply and demand dictating prices. Farmers have some option to adjust timing of production to meet periods of expected higher prices. Exporters are dependent on the prices achieved for shipments. Contract farming is not currently practiced.

Commercialised farmers' risk management needs

4.19. **Commercialised farmers** (or farmers intending to move into commercial production) require **access to finance** in order to invest in land clearance from rocks, equipment including irrigation, machinery, tools, improved seeds, and inputs such as fertilizers, herbicides etc. They also need access to information on appropriate agricultural practices, market information, and linkages to export or domestic buyers. Whilst it is clear that production risk, and specifically weather risk, is a constraint to lenders, it is also evident that decisions of lenders are based on many other factors: poor history of lending; lack of expertise in assessment of agricultural lending (particularly risk and client assessment), lack of collateral, and a limited potential market opportunity for such lending. As well established in the F&V sector strategy, there are many constraints to be addressed, of which insurance for weather (or wider) risks is one.

4.20. The majority of production risks facing farmers, except for cyclone and tsunami, are manageable by farmers, given the favourable climatic conditions for F&V production in Samoa. While cyclone is by far the most important production risk, with a history of substantial associated economic disruption, there are other non production risks which cannot be controlled, notably loss of market, which

[25] Ward, R.G & Ashcroft, P. (1998). Samoa: Mapping the Diversity. Institute of Pacific Studies, USP.

can give rise to loss of income. For reasons stated later, it is not realistic that broad insurance cover for multiple perils, or that credit guarantee could be provided, but insurance limited to cyclone is more realistically possible.

4.21. The **vulnerability** of commercial farmers to loss is also very dependent on the type of crop grown, and degree of diversification. Short cycle F&V crops (e.g. tomatoes, and cabbage)…) have lower financial impact as they are often grown sequentially and loss of income is short term. Medium cycle crops (e.g. banana) are both susceptible to damage, and have longer periods (9-10 months) before returning to production. Loss of the crop from perennial tree crops (coconut, breadfruit) is also for up to a year, but loss of the tree itself has far more serious financial consequences. These will affect the assessment of damage and, particularly, loss of income.

Subsistence farmers' needs

4.22. Subsistence farmers (farmers growing for home consumption, with limited market sales) rely on informal risk management, at household or community level. They are not farming commercially, and have diversified sources of income, and high reliance on remittances. Whilst these households can suffer routine losses, they are managed outside of any formal mechanisms, such as insurance. When a major disaster occurs, they are assisted by the safety net operated by government of disaster relief, backed by donors.

4.23. Supply of formal insurance to subsistence producers is highly unlikely to be viable. Instead, it seems more realistic to build on the Disaster Management Plans being implemented already at the village level, with specific disaster planning adapted to rehabilitation of agricultural production, and food security following a disaster.

Processors and exporters' needs

4.24. Processors are able to insure against loss of assets and stocks, but less easily for consequential loss. A major risk of consequential loss to exporters and processors is a disruption in the supply of raw produce. Generally there is only a very limited ability to source alternative supplies or increase alternative activities. As evidenced after cyclones Ofa and Val, severe cyclones can lead to the collapse or long term depression of agricultural industries which are important to the Samoan domestic and export economies.

Chapter 5: Review of Risk Management Options

Overview

5.1. The analysis presented in chapters 2 to 4 provides some conclusions on the needs for, and potential role, for strengthened risk management, to support farmers and organisations within the F&V supply chain in Samoa. There are different **needs** for commercialized farmers from subsistence households, although a spectrum exists between these two categories of farmers.

5.2. **Options** for risk management which have been considered in this chapter include (1) individual farmer traditional indemnity crop insurance; (2) weather index insurance for farmers; (3) catastrophe insurance linked to disaster relief; and (4) improving access to finance through other forms of collateral or through contractual arrangements, possibly linking finance to input supply (e.g. contract farming, export contracts, formal supplier contracts). The chapter reaches some **conclusions and recommendations** for consideration.

Option 1: Crop insurance provision in Samoa: traditional indemnity insurance for farmers

5.3. In common with the situation in most countries dominated by small scale farmers, subsistence or semi-commercialized farmers, agricultural insurance is not available in Samoa.

5.4. Traditional insurance can be defined as an insurance programme offered to each farmer individually, with crops insured for their sale value or cost of production, and claims paid based on the extent of damage to those crops (see Annex 1). The two main types of traditional insurance are **named peril**, which insures against the dam age from a specified peril or perils only, and **multiple peril insurance** (often called MPCI or multiperil) which covers against reductions in yield from causes other than mismanagement. There are a number of key constraints to the willingness or ability of insurers to provide traditional crop insurance in Samoa. These include:

a) the **small market size.** The potential premium pool for traditional insurance is very low and probably would be limited to some sales to commercial farmers. Subsistence or small scale farmers are unlikely to be interested in taking an individual policy.

b) For the insurance company, there is a **high cost associated with the administration** of numerous low value policies, as well as a high cost of marketing or distribution. These costs are generally considered to be prohibitive.

c) There is an extremely **small geographical production area.** This means that a single event can cause a widespread catastrophic loss, which may be unaffordable for insurers or take a unacceptably long period of time to subsequently offset with revenues from premiums.

d) **Cropping is diversified** with each farmer typically growing a range of fruit and vegetable crops. Each crop type has a different risk of loss and different value per planted hectare, which makes the technical aspects of establishing an insurance programme more complicated.

e) In order to offer insurance, the asset to be insured needs to be accurately defined. The **lack of registration** of farmers and information on the area of land they have planted or available for planting is a major hindrance, as without collecting data about each farm at the time of policy sales, there is no way to define what is being insured.

f) In any non compulsory insurance programme, there must be a willingness by the farmer to purchase insurance. When insurance is first offered, it is inevitable that there will be **farmer distrust and unfamiliarity** with insurance which constrains sales. The demand for insurance is also often limited by the low frequency of events. If major losses have not occurred for a long period of time, they tend to be considered as unimportant, even if the annualised loss from these events is substantial. Cyclone damage is a major risk in Samoa, yet there has not been a catastrophic event since 1991.

g) Insurers require **data to set premium rates**. For a traditional insurance scheme, this needs to be annual data quantifying crop losses or yields and the associated perils. Such data does not exist in Samoa.

h) Traditional insurance is dependent on the ability to **assess claims accurately and quickly**. When insurance is first introduced, assessors must be trained in the loss assessment methodology for each crop type and for each insured peril. After a catastrophic event there can be an enormous demand for loss assessors.

There are no insurers in Samoa with specialist knowledge in design of appropriate products, or operational needs.

5.5. A finding in other countries is that "stand alone" development of crop insurance (whether traditional or index), without being **integrated into a package** which addresses other constraints (finance, inputs, advisory services…), is not of interest or seen as a value proposition by farmers. **In Samoa, any such packaged approach would only be relevant to commercial producers.** Realistically, the consultants do not believe that the development of traditional insurance for crops is feasible, for the reasons provided in 5.4.

5.6. In Samoa, insurance was not seen as a key constraint to provision of finance by the DBS. Clearly, however, some form of protection against events as catastrophic as cyclone should be seen as of value; even if at present, ad hoc aid provision after an event is overwhelming. More interesting is to consider how disaster assistance adapted to agriculture, possibly through disaster assistance protected by catastrophic insurance, could serve the needs of a wider clientele than the small number of commercial producers, but at the same time act as one form of collateral enhancement against lending for any commercial producer.

Option 2: Crop insurance provision in Samoa: non-traditional insurance

5.7. In other countries, there has been a strong recent interest in, and development of, index insurance. Many schemes are at a pilot scale, with limited market expansion. Index insurance is a simplified type of insurance, designed to allow delivery of payouts to all farmers in defined geographical areas, either triggered by a weather event (weather index insurance) or an average yield reduction over a defined district (area yield insurance). There are a number of possible features of non-traditional crop insurance programmes which would remove many of the constraints associated with traditional insurance programmes that are listed in paragraph 5.4 above.

a) Rather then being based on the occurrence of damage to a crop, weather index insurance is based on the occurrence of a weather event. This means that there is no reliance for setting premium rates on the very sparse statistics that exist about previous crop losses. Rather premium rates are based on the risk of occurrence of a weather event, such as a cyclone, and there is plentiful data available for assessment of the hazard frequency.

b) If insurance is limited to catastrophic and unmanageable perils, such as tropical cyclone, then there will be a strong relationship between the occurrence of the defined weather event and damage to the crops in a specified area. This is because crops will be wiped out across a large area with similar levels of damage throughout.

c) The occurrence of a cyclone can be readily defined. At its simplest, the definition may state that an insurance payment is triggered when a cyclone of a specified category reaches a specified proximity to the coastline, according to the readily available best track satellite data. At its most sophisticated level, the definition may be based on a model of the windfield surrounding each cyclone and the windspeeds predicted from the model at the locations where crops are grown (see Annex 2).

d) Any insurance payment can either be made in full once the predefined weather event has occurred, or alternatively be made incrementally depending on the severity of the predefined weather event.

e) The country could be divided into a few very large geographical homogeneous zones. If a zone is struck by the cyclone, as defined in the insurance policy, then all insured farms in the zone would qualify for an insurance payment. Establishing such zones would require technical work.

f) Under such a programme, it is the occurrence of a cyclone which triggers the insurance payment. There are then several options for the distribution of such a payment, but under each option **there must be a system of registering the farmers who are insured**.

   i) If the policy was held by the Samoan Development Bank, then the register of insured farmers could be those who have a loan. The lump sum insurance payment could be used to make payment of the interest and/or principal of all loans to farmers within the homogeneous geographical area affected by damage. There would be no loss assessment in the field.

   ii) If the policy was based on a register of individual farmers, then the lump sum insurance payment could be distributed based on the number of planted hectares each registered farmer within the homogeneous geographical area affected by damage. There would be no need for loss assessment. An organisation able to hold such a group policy would still be needed: e.g. a farmer association, or possibly a village administrative structure.

   iii) If the policy was based on a register of individual farmers as in (b), then, in theory, the lump sum insurance payment could also be distributed according to the damage that has actually occurred on the number of hectares planted by each farmer within the homogeneous geographical area affected by damage. This method would require, however, on-the-ground loss assessments to be conducted, and very clear rules under which decisions on such apportionment would be made in a transparent and objective manner. In practice, such a system could be contentious and difficult to implement.

   iv) If membership of the programme was compulsory for all farmers (or alternatively for all villages) then there would be an understanding that all agricultural land was insured. On this basis the total area of agricultural land in each village could be itemised in an insurance schedule. Premiums would be levied on the total area of agricultural land. Claims would be paid in lump sums to affected villages, and it would be up to the nominated village representatives to distribute the claim payments to individual farmers.

f) Insurance payments do not have to be cash payments. Payments in kind, such as providing the inputs necessary for the reestablishment of damaged crops such as seeds, fertiliser and labour, are also possible.

g) Premium rates may be subsidised or fully paid by governments, especially for a base level of catastrophe insurance cover sufficient to enable re-establishment. Farmers opting to take cover providing higher insurance payouts can do so by paying an additional premium themselves.

5.8. There are also a number of constraints associated with the implementation of non-traditional (index) insurance products, which would still need to be overcome in Samoa. Any insurance programme, including non traditional ones, are dependent on a register of the assets which are to be insured. Currently there is no register of farmers in Samoa, but there are several possible methods of developing such a register:

a) The Disaster Management Office is already part way through the development of a register of individual villages including the area planted to agriculture and crop types. This option is explored further as Option 3.

b) Data already exists from both the 2009 agricultural census, and from taxation exemptions (farmers are exempt from paying tax) which identifies “farmers” and their activities. However the legality of using this data for insurance programme registration is uncertain and unlikely to be accepted by farmers.

c) If insurance premiums were subsidised or even fully paid, then farmers could only be eligible for the subsidy after providing the relevant registration details. This would provide an incentive to farmers to join such a register.

d) Some other organisations, such as Women in Business Inc, the Farmers Association, exporters and processors already have partial registers of farmers.

e) As above, the scheme could be limited to farmers with a loan from the Samoan Development Bank, which already holds a database of loanees.

5.9. Neither is there a widely adopted definition of what constitutes a “farm”. The definition of a farm is important given the prevalence of small farms predominantly used for subsistence or for a combination of subsistence and limited sales of produce. For the purposes of the agricultural census, a “minor agricultural activity” is defined as a cropped area of less than 625 square yards or less than 20 trees. A definition of a “farm” would be required for most insurance programmes, or alternatively a definition of what constituted “farm land” if all farmland was to be able to be insured.

Option 3: Non-traditional index insurance linked to the Disaster Management Office.

5.10. This is similar to option 2, but involves the Disaster Management Office, especially in the calculation of payments made to farmers. If a non traditional insurance programme was to be established, there remains a requirement for administration of the programme, and in particular setting insured values, recording who and what is insured, collecting premium and assessing loss and making payments. Linking an insurance programme to the Disaster Management Office introduces the potential to utilise the data gathered and functions already undertaken by the Disaster Management Office, and also to base claim payments on a "double trigger" – that is a) the occurrence of a predefined weather event; and b) the occurrence of damage and its measurement at the farms receiving payments from DMO.

5.11. An insurance programme could pay claims at a fixed and agreed value per hectare. Valuing crops in this way is dependent on first knowing the area of crops planted and their location. In the event of a total loss, this amount would be paid in full. If partial losses were also to be covered by the programme then a proportion of this amount could be paid depending on the extent of damage. The fixed agreed value per hectare could be:

a) The same for all crop types, or varied per crop type depending on their value.

b) Based on the costs of production or potential revenue of the crop. These figures are generally based on industry gross margins for crop production, and these have already been developed for Samoa.

c) Insurance payments can be made in kind – for example through the provision of the materials and labour necessary for rehabilitation.

5.12. Payouts could be made when

a) A farm suffers a 100% loss. This simplifies loss assessment since it is generally plainly apparent when a farm will have no production following a weather event.

b) When a farm suffers damage above a predefined threshold (deductible or excess, expressed as a percentage). Payment on this basis would be dependent on an in-field measurement of losses. In this regard, the processes already followed after a catastrophic event may be able to be modified and enhanced to meet the requirements for an insurance programme.

5.13. At present, losses are assessed by DMO and government agencies, following a catastrophe using the Economic Commission for Latin America and the Caribbean (ECLAC) methodology[26]. Under this system the immediate effects of the event are classified as damage (destruction of physical assets). Following effects are categorised as losses, and these are typically consequential losses and business interruption. Assessments are made for each sector of the economy of which agriculture is one. The six stages in the assessment are:

a) A determination of the assets which existed before the disaster (eg: planted agricultural area and time of year at which crops are produced), and the state of their financial performance (eg: volume of production, yields and prices), is made.

b) The situation after the disaster is determined. This includes a measurement or assessment of the extent of damage to physical assets as well as an estimate of the likely time for reconstruction to reach full recovery.

[26] Disaster, Damage Loss and Needs Assessment Training Guidelines, 2008. World Bank

c) Sector performance after the catastrophe is measured using known indicators (eg: value of agricultural production or exports, sales prices at markets)

d) The value of damage and losses is estimated. In the case of agriculture there needs to be care not to double count losses, since many raw products are processed and become part of the revenue of "industry".

e) The macro-economic impact is determined by assessing the impact on GDP, balance of trade and the government budget.

f) The impact on personal income is assessed. Losses in production are converted to lost employment, and the value of lost earnings to individuals thereby calculated.

5.14. Insurance assessments generally follow a different methodology. Step a) of the ECLAC assessment, to determine the pre disaster value, is completed in advance of issuing an insurance policy and forms the insured value (sum insured). Measurements of losses are based on a measurement of either the level of damage or the reduction in overall production. This assessment method is geared towards establishing the value of losses at smaller unit levels of area than an entire economic sector – for instance individual farmers or villages. There are well established procedures for this style of insurance loss assessment and it would be possible to complete the ECLAC assessments in a little more detail and additionally meet the requirements for insurance purposes.

5.15. The impression is that assessments of agricultural losses after the Tsunami in 2009 were relatively cumbersome and slow in respect of agriculture, with an overstated outcome. Training in the agricultural insurance assessment methodology could be provided to selected local personnel. Assessments could supervised or supported by relatively few specialist international personnel trained in agricultural loss assessment for insurance.

5.16. Additional planning in advance of a disaster occurring would be beneficial, and in particular improving the knowledge of what crops existed beforehand and their value. The register being completed by the Disaster Management Office will be invaluable in this regard. Modern technology, such as satellite imagery, could be used to enhance on the ground survey work and may provide additional information on crops which existed prior to the damage (as well as afterwards.)

5.17. Under option 3, there are two main alternatives were considered as to the way an insurance contract could be structured, and procedures for settlement of payouts to farmers made.

a). With DMO as the Policyholder **("Macro" level index policy, option 3a).** DMO would pay the premium sourced from government and donors, receive the fixed triggered lump sum payout from a claim on the policy, such claim being determined by storm strength. DMO in association with ministries under the Disaster Management Plan would carry out loss assessments, and administer the distribution of claims to farmers according to rules it establishes (strengthened registration of farmers, setting scale of payouts, establishing improved assessment of damage…). Differences between the amount triggered as payment under the policy, and the aggregate amount of assessed damages could differ. The insurance policy could be structured to make payments to a Fund established for catastrophes, with the fund absorbing these differences.

b). With DMO acting as distributer of the insurance product, but with individual farmers being policyholders **("Micro" level index policy, option 3b).** This micro approach implies a much more rigid and formalised approach to index insurance, where the insured farmers are named in a master policy held by DMO. On the occurrence of an event, agreed value payouts are automatically made to farmers, based on the strength of the storm, and without individual in-field loss assessment. *The consultants do not recommend pursuing this option 3b, until a later phase and after there was successful introduction of, and evaluation of, option 3a. It is not clear if there is a role for individual farmer index insurance, except* *for commercial farmers. This option 3b would be technically and organisationally significantly more complex to develop and implement than 3a, given the absence of pre-conditions noted in this report, including farmer registration, the diversity of the F&V sector and small farm size.*

A conclusion of this study is that Option 3a offers the most realistic option of managing the impact of cyclone risk, involving both practical measures for preparedness and post-event recovery, linked to risk transfer, providing rapid financial response to DMO for implementation. It also allows for integrated fund management by government, for centralised management of a fund for insurance recovery and donor assistance. Further, it concentrates efforts on practical measures for on-the-ground risk management (preparedness, recovery, training,..) rather than raising the expectation that insurance is a sole solution to risk management. Key features of Option 3a and 3b are shown in Table 5.1, and are elaborated in more detail in Annex 2.

Table 5.1

Comparison of features of Option 3a, and comparisons to Option 3b

Feature	**Option 3a: Macro index policy**	**Option 3b: Micro index policy**
Policyholder	DMO (government disaster fund)	Registered Farmer
Insured peril	Cyclone event	Cyclone event
Policy trigger	Cyclone strength or distance, or modelled windfields (see annex 2)	Cyclone strength or distance, or modelled windfields (see annex 2)
Payout to policyholder	Agreed payout scale based on cyclone strength (see annex 2)	Agreed payout scale based on cyclone strength (see annex 2)
Sum insured	Agreed aggregate value based on DMO village surveys	Agreed value per crop type based on farmers declared crops, intended as an additional payment to 3a
Premium	Paid by government and/or donor organisations	Paid by farmer
In field loss assessment	DMO manages distribution of payout to farmers, based on field assessment	Direct insurance payment to farmer, agreed scale based on cyclone, (no field assessment)

Option 4: Improved collateral and contracting arrangements in the supply chain.

5.18. This option recognises that insurance options (as in options 1-3) are not a "panacea", as is often attributed to the role of index insurance as a tool to manage agricultural risk. In particular, insurance is technically and organisationally challenging for agriculture in any small farmer communities, and Samoa is no exception. Other options to achieve a) income smoothing for farmers following shocks; and b) promotion of investment, access to finance and productivity have to be considered as potential measures for risk management.

5.19. FAO and UNCTAD are jointly pursuing ways in which improved collateral could be made available to lenders in the F&V supply chain. Where there is potential for formal marketing of crops, linked to a final buyer or export market, in theory there could be collective funding of a supply chain, with risks shared with each beneficiary in the supply chain. Arrangements for managing the financial impact of shocks would be built into the contract provisions, and agreed with any financing institution, for example through agreed rescheduling or access to a collective insurance policy to transfer major risks such as cyclone. "Supply chain finance" can benefit from risk sharing between the producers and the processors, buyers and exporters. A collective, pre-planned and contractually established approach to managing risks in the supply chain provides a firmer basis of security for lenders. Such an approach can only be seen in the context of either specific supply chain contracts of supply (to designated buyers), or in an integrated programme to facilitate investment into improvements is being made, which may include supply arrangements with emergent farmers. Examples of this approach are the WIBI schemes for organic produce. These conceptual ideas will be investigated further by FAO and UNCTAD.

External assistance to Samoa relevant to Agricultural Risk Management and insurance

5.20. There is a high degree of donor, NGO and IGO activity in the Pacific region, and several of these programs have overlapping interests in agricultural risk management, supporting governments. In Samoa, within AAACP, these include the Fruit & Vegetable Sector Strategy for Samoa (ITC), and the supply chain finance and risk management proposals and survey of credit demand in the F&V sector (FAO/UNCTAD). The Pacific Financial Inclusion Program (PFIP), is developing micro finance and micro insurance in the region, and is interested in risk management in agriculture. UNDP, SPC, SOPAC, and regional or national organisations are heavily involved in climate change adaptation projects, involving risk management, including for agriculture. In Samoa, preparation for the World Bank's SACEP loan, which has a component for F&V sector, is proceeding. The present study is complementary to these programmes. In relation to climate change adaptation and food security, the efforts to increase productivity, develop the commercial sector, and improve the effectiveness of the F&V supply chain, can be the most important factor to improved resilience.

5.21. The present study has concentrated on assessment from the "ground up" and practical approach for measures for risk management in agriculture in Samoa, and particularly, how insurance might be integrated into the disaster risk management program. The technical work of the **Pacific Catastrophe Risk Financing Initiative** (PCRFI) is of particular relevance, in that significant work has been undertaken, in conjunction with SOPAC, AIR Worldwide, and national governments, to see if a risk pooling protected by reinsurance is feasible and of interest to island states. The initiative is similar to the Caribbean Catastrophe Risk Finance Facility (CCRIF), which is implemented and provides governments with immediate post-disaster funding. Of interest (both in the Caribbean and Pacific), is whether insurance cover can be designed to respond to meet specific agricultural sector needs, as opposed to an aggregate payout directed to the Treasury. The specific financial structuring (risk layering, to design any risk retention/funding, and risk transfer through reinsurance or PCRFI), would need to be designed once a ground-up scheme is identified which best meets the needs of the government. At the current stage, the most important spin-off from the PCRFI is its technical work in the risk modelling which has been carried out, which can provide a basis for **triggering** the payments for cyclone events. Payouts based on modelling can act as a more refined basis for a payout scale than simply tracking a cyclone's closest point of approach, and storm strength. The trigger options are described in Annex 2, based on work currently being carried out in the Caribbean.

Conclusions on Risk Management Options

The following are main findings of this study:

a) Cyclone is the key unmanageable risk faced by the agricultural sector, in terms of potential for widespread, significant damage, and where an insurance mechanism could benefit Samoa. Market based crop insurance at an individual farmer level, whether traditional indemnity insurance, or index crop insurance, is not realistically considered as operationally or financially viable for perils other than cyclone.

b) Strengthening the disaster risk management planning and implementation by DMO (Option 3) provides an excellent backbone for practical implementation of preparedness, and planning of relief, recovery, post-event food security, from hazards and particularly cyclone, in the agricultural sector. Linking the financing of in-kind recovery needs, and/or payouts to affected households, through insurance linked to the DMO, could be feasible. The linkage of index based insurance with the DMO is considered more realistic than distribution to individually insured farmers through other channels (Option 2).

c) Such a proposal would be most likely to be feasible if structured, in a first stage, where DMO (or other designated government agency) was the policyholder for a triggered index policy (a "macro" scheme, Option 3a). Payout rules would be established based on DMO assessment methodology including damage assessment linked to farmer registration. However, a second and later stage could be foreseen, where farmers could individually purchase indexed cyclone cover as a top-up to the cover provided under the DMO plan (Option 3b).

d) Building a layered structure for risk financing is outside the scope of this report, but could include development of a fund, backed by reinsurance, the Pacific Catastrophe Risk Financing Initiative, and the widely available donor funding. An advantage of the insurance and reinsurance approach is a faster and more pre-planned financial response to major events than is possible by ad hoc and ex post donor funding and appeals. Although risk transfer is important, the most important initial consideration relates to ground-up planning of strengthened agricultural risk management measures.

e) Apart from cyclone (and tsunami or volcanic eruption), most risks to agriculture are non-catastrophic are to a large extent controllable by good farm management practices. Traditional crop insurance, or index insurance adapted to these other perils, is not considered realistic or feasible in Samoa due to the predominance of subsistence farmers, and due to the lack of a business case for the insurance sector, from the limited number of commercial producers. Programs which strengthen the value chain (e.g. markets, improved inputs) and promote good agricultural practices, and informal risk management mechanisms, such as savings, community based actions as well as governments' efforts in disaster planning, can all contribute to risk improvement for the F&V sector, and overall food security. Microfinance and microinsurance can contribute to security of small scale farming households, even if agricultural insurance is not available.

f) Access to finance, and the availability of agricultural credit, remains an issue which would only partially be addressed even if formal insurance against cyclone was introduced. Multiple Peril Crop insurance (which approaches to a production guarantee) is not feasible in Samoa. Access to credit is a concern mainly for emergent or commercial farmers. Systems which can enhance collateral, develop supply chain finance through contractual arrangements to domestic buyers and exporters, pre-agreed loan rescheduling, and formal development programs providing investment funds linked to technology and extension services, can contribute to managing localised losses and production volatility. Achieving improved productivity and profit reduces risk, although commercialisation can result in less crop diversification. Option 4 is being pursued under AAACP by FAO and UNCTAD.

Annex 1: Crop insurance product descriptions

There is no crop insurance in Samoa. One objective of the present study is to determine the opportunity, or otherwise, of introducing appropriate forms of agricultural insurance which could provide protection against weather risks, thereby reducing farmer indebtedness following loss, and providing a form of collateral to lending institutions. World Bank's Agricultural Risk Management Team has been extensively involved in developing innovative index-based weather insurance, a product which intend to allow major weather risks (particularly drought) to be insured in small-farmer communities. This Annex provides some background on traditional and index insurance products. A product for cyclone risks is being researched in Jamaica, and details are provided in Annex 2. Traditional forms of yield-based, multiple peril, crop insurance have proven difficult or impossible to operate in developing countries, due to limited capacity of local insurance markets, difficulties of conducting in-field loss assessment, high cost, and adverse selection (only the high risk farmers insuring).

Box 1 summarises the main types of crop insurance globally. There are two types of index insurance which have been developed to address some of these constraints: weather-based index and area-yield index insurance. The main focus of index insurance in developing countries has been the application of weather-based indices, which make payouts based on measurements of weather parameters, such as rainfall, at meteorological stations. Index-based insurance presents some additional challenges, particularly basis risk (see Note 1 in Box 2 below).

Box 1: Summary of Various Types of Agricultural Insurance Products

Traditional Crop Insurance

Damage Based Indemnity Insurance (Named Peril Crop Insurance). Damage based indemnity insurance is crop insurance where the insurance claim is calculated by measuring the percentage damage in the field, soon after the damage occurs. The percentage damage measured in the field, less a deductible expressed as a percentage, is applied to the pre-agreed sum insured. The sum insured may be based on production costs, or on the expected revenue. Where damage cannot be measured accurately immediately after the loss, the assessment may be deferred until later in the crop season. Damage based indemnity insurance is best known for hail, but is also used for other named peril insurance products (e.g., frost and excessive rainfall).

Yield Based Crop Insurance (Multiple Peril Crop Insurance, MPCI). Yield based crop insurance is insurance where an insured yield (e.g., tonnes/ha) is established, as a percentage of the historical average yield of the insured farmer. The insured yield is typically between 50% and 70% of the average yield on the farm. If the realized yield is less than the insured yield, an indemnity is paid equal to the difference between the actual yield and the insured yield, multiplied by a pre-agreed value of sum insured per unit of yield. Yield based crop insurance typically protects against multiple perils meaning that it covers many different causes of yield loss. This is because it is generally difficult to determine the exact cause of loss.

Index Crop Insurance

Area Yield Index Insurance. Area yield index insurance is insurance where the indemnity is based on the realized average yield of an area such as a county or district. The insured yield is established as a percentage of the average yield for the area. An indemnity is paid if the realized yield for the area is less

than the insured yield regardless of the actual yield on a policyholder's farm. This type of index insurance requires historical area yield data.

Weather Index Insurance. Weather index insurance is insurance where the indemnity is based on realizations of a specific weather parameter measured over a pre-specified period of time at a particular weather station. The insurance can be structured to protect against index realizations that are either so high or so low that they are expected to cause crop losses. For example, the insurance can be structured to protect against either too much rainfall or too little. An indemnity is paid whenever the realized value of the index exceeds a pre-specified threshold (e.g., when protecting against too much rainfall) or when the index is less than the threshold (e.g., when protecting against too little rainfall). The indemnity is calculated based on a pre-agreed sum insured per unit of the index.

A summary of advantages and disadvantages of index insurance are provided in Box 2.

Box 2: Summary of advantages and challenges of index-based insurance

<table>
<tr><th>Advantages</th><th>Challenges</th></tr>
<tr><td>Less moral hazard
The indemnity does not depend on the individual producer’s realized yield.

Less adverse selection
The indemnity is based on widely available information, so there are few informational asymmetries to be exploited.

Lower administrative costs
Does not require underwriting and inspections of individual farms.

Standardized and transparent structure
Uniform structure of contracts.

Availability and negotiability
Standardized and transparent, could be traded in secondary markets.

Reinsurance function
Index insurance can be used to more easily transfer the risk of widespread correlated agricultural production losses.

Versatility
Can be easily bundled with other financial services, facilitating basis risk management.</td><td>Basis risk (note 1)
Without sufficient correlation between the index and actual losses, index insurance is not an effective risk management tool. This is mitigated by self-insurance of smaller basis risk by the farmer; supplemental products underwritten by private insurers; blending index insurance and rural finance; and offering coverage only for extreme events.

Precise actuarial modeling
Insurers must understand the statistical properties of the underlying index.

Education
Required by users to assess whether index insurance will provide effective risk management.

Market size
The market is still in its infancy in developing countries and has some start-up costs.

Weather cycles
Actuarial soundness of the premium could be undermined by weather cycles that change the probability of the insured events (i.e. El Niño events).

Microclimates
Make rainfall or area-yield index based contracts difficult for more frequent and localized events.

Forecasts
Asymmetric information about the likelihood of an event in the near future will create the potential for intertemporal adverse selection.</td></tr>
</table>

Source: World Bank (2005)[27]

Note 1: Basis Risk: Since index-insurance indemnities are triggered by exogenous random variables, such as area yields or weather events, an index-insurance policyholder can experience a yield or revenue loss and not receive an indemnity. The policyholder may also experience no yield or revenue loss and still receive an indemnity. The effectiveness of index insurance as a risk management tool depends on how positively correlated farm yield losses are with the underlying index.

[27] World Bank, *Managing Agricultural Production Risk: Innovations in Developing Countries*, 2005.

Annex 2: A draft example insurance product outline linked to disaster risk management

The following product drafts show further details of Options 3a and 3b. These drafts are intended solely as examples, to assist in understanding of how such products could operate.

Option 3a: Example Insurance Structure for a Macro product	
Insurer	An international reinsurer with the ability to issue policies in Samoa, **or** a local insurance company backed by substantial reinsurance
Geographical Scope	The Islands of Upolu and Savaii
Policy Holder	The Disaster Management Office (DMO) as manager of fund for disaster relief and rehabilitation payments.
Insured farmers	All farmers would be automatically insured under this scheme, but would be required to register. The insured land area would be identified by the Disaster Management Office (DMO) in its register of insured villages.
Insured Perils	Tropical cyclone only.
Insurable Crops	Root crops (including taro, yams, ta'amu, cassava), fruit crops (including papaya, banana, passionfruit), vegetable crops, breadfruit, coconuts, cocoa.
Insured Value (Sum Insured)	The sum insured would be a fixed agreed value for each planted hectare of crops . For simplicity, only a few sums insured per hectare would apply, e.g. high medium and low value crops.
Premium Payable	The premium payable would be a function of both the sum insured and the pricing done by tender in the international reinsurance market, based on analysis of expected frequency and severity of claims.
Limit of Liability	Either the sum insured, or a limit lower than the total insured which would lower the premium cost.
Premium Payment	The policy premium would be paid by the Samoan Government or donor organisations. The insurance would provide a lump sum payment to DMO a contribution (full or partial) to the payment of lossess as assessed by DMO and agencies.
Policy Trigger **(see note 1)**	Option 1: A claim under the policy would only be payable once a tropical cyclone of category 3 or more came within 200km of the coastline of Savaii or Upolu, and a graduated payout scale established according to severity and closest point of approach. Cyclones would be tracked using the Joint Typhoon Warning Centre best track data. Option 2: windfields associated with the event, as modeled by an independent modeling firm (e.g. as per methodology of Pacific Catastrophe Risk Insurance Initiative)
Amount of Claim Payment **(see note 2)**	The claim payment would be an agreed value based on the loss event severity, and sum insured, as per scale established in the policy. There would be no account taken of actual damage in the field. Claims would be paid to the Disaster Management Office.
Loss Assessment	The payment made by the policy is not linked to any field loss assessment. However, DMO would conduct the normal assessment using procedures for ECLAC procedures already adopted after major loss events.

Option 3b: Example Insurance Structure for a Micro product (Top up cover)	
Insurer	A local insurance company backed by substantial reinsurance
Geographical Scope	The Islands of Upolu and Savaii
Policy Holder	Individual farmers would be insured, which could be under the management of Disaster Management Office (DMO) holding a master policy on behalf of insured farmers.
Insured farmers	Individual farmers would elect to be insured as a "top up" to the buy additional cover to any provided under the DMO main scheme (option 3a). Farmers would be required to register.
Insured Perils	Tropical cyclone only.
Insurable Crops	Root crops (including taro, yams, ta'amu, cassava), fruit crops (including papaya, banana, passionfruit), vegetable crops, breadfruit, coconuts, cocoa.
Insured Value (Sum Insured)	The sum insured would be a fixed agreed value for each planted hectare of crops. For simplicity, only a few sums insured per hectare would apply, e.g. high medium and low value crops.
Premium Payable	The premium payable would be a function of both the sum insured and the pricing done by tender in the international reinsurance market, based on analysis of expected frequency and severity of claims.
Premium Payment	The policy premium would be paid by individual farmers
Policy Trigger **(see note 1)**	Option 1: A claim under the policy would only be payable once a tropical cyclone of category 3 or more came within 200km of the coastline of Savaii or Upolu, and a graduated payout scale established according to severity and closest point of approach. Cyclones would be tracked using the Joint Typhoon Warning Centre best track data. Option 2: windfields associated with the event, as modeled by an independent modeling firm (e.g. as per methodology of Pacific Catastrophe Risk Insurance Initiative)
Amount of Claim Payment **(see note 2)**	The claim payment would be an agreed value based on the loss event severity, and sum insured, as per scale established in the policy. There would be no account taken of actual damage in the field. The claim would be paid to the farmers' bank account
Loss Assessment	Under this product, claims would be on an agreed payout, related to event severity (as above) and without field assessment. (individual farmer loss assessment for small farmers does not seem likely to be feasible).

Note 1. Two options for the parametric trigger are possible. The *first option* shown, using a measurement of the closest point of approach, and cyclone strength at that point, is relatively easy to implement, since cyclone path data is independently available through the Joint Typhoon Monitoring Centre. However, there are variable intensities and fall-off of wind from the cyclone centre, and a scale developed on this will give rise to basis risk (difference between the expected wind and actual wind). The *second methodology* allows for much more accurate estimation of winds at any location on the island for a specific event, since models take into account multiple factors such as forward speed of the cyclone, pressure gradients, topography etc. A disadvantage is that it is more expensive and technically complex to establish such a model. However, similar modeling is being carried out under the Pacific Catastrophe Risk Financing Initiative, with which collaborative effort could be foreseen. Generally, approach 2 is recommended and certainly for a micro level scheme.

It should also be noted that **basis risk** will arise because even if winds can be accurately modeled, the exact damage caused by those winds on crops cannot be predicted, not least due to the diversity of crop types, growth stages etc. Further, it could be very difficult (after the event) to confirm that areas insured were genuinely planted. For this reason of high likely basis risk, two approaches are adopted. First, the insurance is not sold as a "crop insurance" but as an "agreed-value payout wind insurance" policy. Secondly, only severe events should be covered, since damage in severe events is likely to be more uniform. Thirdly, if basis risk is likely to be very high, then a "macro" policy, providing a lump sum payment to an organization able to verify damage in-field, is preferable (see note 2).

Note 2. Ultimately, loss assessment is the only way in which to target payments to those farmers who have actually suffered damage, where partial losses exist. Only where there is 100% loss on all crops, is the field assessment need reduced, as a total loss can be declared. For a micro scheme designed simply with an agreed value payout based on (for example) modeled winds (and no field loss assessment), the extent of expected basis risk, have to be researched. This also relates to the zoning decided in establishing Homogenous Zones, into which farmers would be enrolled, and within which the same payouts would be made (agreed payout scale for the event x sum insured per farmer). A scheme of "cyclone vouchers" – where agreed-payout vouchers (without assessment of damage) are sold to farm households or anyone demonstrating an insurable interest in cyclone (e.g. an input supplier) is a valid concept, but differs significantly from classical indemnity insurance, which relies on the measurement of the amount of loss. The payout will not relate to exact loss, and can be considered as an income supplement during a period of financial stress. This issue has been addressed by regulators of insurance in many countries, where index insurance has been approved.

As noted, the financial situation after a cyclone is much affected by remittance payments and donors. This applies both at government level, where donor funds are provided to government, who control the disaster payouts, but also at household level, where remittances are received.