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Agricultural Insurance Pre-Feasibility Study

Volume I Main Report

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FOREWARD

The Papua New Guinea Agricultural Insurance Pre-Feasibility Study is set out in two volumes:

Volume I: Main Report containing the study findings, conclusions and recommendations, and

Volume II: April 2013 Agricultural Insurance Pre-Feasibility Study dissemination workshop findings and next steps.

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ABBREVIATIONS

AYII	Area Yield Index Insurance
CCA	Climate Change Adaptation
CIC	Coffee Industry Corporation
CCRIF	Caribbean Catastrophe Risk Insurance Facility
DRM	Disaster Risk Management
ENSO	El Niño Southern Oscillation
GFDRR	Global Fund for Disaster Reduction and Recovery
GIS	Geographic Information System
GoPNG	Government of Papua New Guinea
MASP	Mapping Agricultural Systems of PNG
ITCZ	Inter Tropical Convergence Zone
LLG	Local Level Government
MPCI	Multiple peril crop insurance
NADP	National Agricultural Development Plan
NAIS	National Agricultural Insurance Scheme
NARI	National Agricultural Research Institute
NDVI	Normalised Difference Vegetative Index
OPIC	Oil Palm Industry Corporation
OPRA	Oil Palm Research Association
PCRAFI	Pacific Catastrophe Risk Assessment and Financing Initiative
PFIP	Pacific Financial Inclusion Program
PML	Probable Maximum Loss
PNG	Papua New Guinea
PNGCCI	PNG Cocoa and Coconut Institute
PNGK	PNG Kina *(Currency of Papua New Guinea)*
PNGRIS	Papua New Guinea Resource Information System
PNGSDP	PNG Sustainable Development Program Ltd
PPAP	Productive Partnerships in Agriculture Project
PPP	Public Private Partnership
RS	Remote Sensing
SADP	Small Farmer Agricultural Development Project
SPCZ	South Pacific Convergence Zone
SOPAC	Applied Geoscience and Technology Division, Secretariat of the Pacific Community
SST	Sea Surface Temperature
TC	Tropical Cyclone
TRMM	Tropical Rainfall Monitoring Mission
TSI	Total Sum Insured
UPGN	University of Papua New Guinea
TSU	Technical Support Unit
WII	Weather Index Insurance
WINCROP	Windward Islands Crop Insurance (1988) Ltd
WPM	West Pacific Monsoon

EXECUTIVE SUMMARY

Context

1. ***This report presents the key findings, conclusions and recommendations of an agricultural crop and livestock pre-feasibility study in Papua New Guinea (PNG).*** This study was conducted under the World Bank's Disaster Risk Management (DRM) and Climate Change Adaptation (CCA) Project 2010-13 for PNG. The study was funded by the Global Index Insurance Fund (GIIF) policy and regulatory window managed by Financial Capital Markets Non-Bank Financial Institutions (FCMNB)..

2. ***The objectives of the 2012 agricultural insurance feasibility study*** centred on: (i) a review of the quality and availability of time-series crop and livestock production and loss data and climatic weather data for risk assessment and rating purposes;(ii) according to data availability, to conduct an initial risk assessment for crops and livestock; (iii) to identify the technical, operational, financial and institutional challenges and possible solutions for development of commercial agricultural insurance in PNG and (iv) a review of the institutional issues and options for market-based agricultural insurance in PNG including the potential roles for public and private sectors.

3. ***PNG is very exposed to a range of natural and climatic hazards including earthquakes, volcanic eruptions, tsunamis, cyclones, river and coastal flooding, landslides and droughts (***World Bank 2010a; PCRAFI 2011)**.** The country is located on the Pacific rim of fire and experiences a high frequency of ***earthquakes***, ***landslides*** and ***volcanic eruption***: while earthquakes do little damage to agriculture, volcanic eruption can cause economic losses to plantation crops such as cocoa and coconuts, as experienced under the eruption of Mt Tuvurvur, East New Britain in 1994.

4. ***Rainfall in PNG is strongly influenced by the ENSO-El Niño phenomenon which is associated with droughts while in the La Niña phase excess rain and flooding*** are experienced. In the very strong 1997-98 El Niño which was the strongest event recorded in the 20th century, much of PNG incurred very severe droughts and sweet potato production in the highlands was decimated by a combination of ***drought*** and ***frost***: nearly 1.2 million people or 40% of the rural population were affected by the 1997-98 drought and a major international program of food aid had to be launched (Allen and Bourke 2001). Wild fires also caused considerable damage to forestry and plantation export crops in 1997-98.

5. ***The south eastern provinces of PNG face a considerable tropical cyclone exposure*** and in 2007 TC Guba caused major damage to the oil palm industry in Central and Northern Provinces with losses valued at many tens of millions of US dollars: direct damage to oil palm plantation was incurred by uprooting of trees and by storm surge, while damage to roads and bridges has to this day caused business interruption in the form of inability to transport harvested oil palm fruit to the oil processing mills. PNG is also very susceptible to the adverse impacts of climate change (Australian Bureau of Meteorology and CSIRO, 2011). Coastal agricultural areas of PNG also face an exposure to tsunami and tidal surge as well as coastal flooding caused by rises in sea surfaces levels.

Challenges for designing Agricultural Crop and Livestock Products and Programs for PNG

6. ***In PNG there are a series of key institutional, technical, financial, and operational challenges*** that will be faced in developing crop and livestock insurance products and services that are suited to the needs of the country's predominantly small and marginal farmers.

Institutional Challenges

7. ***There are distinct sub-sectors in PNG agriculture, the large commercial export production estates and agribusiness and then the majority of farmers who are smallholders divided into semi commercial smallholders and small subsistence farmers.*** Any agricultural insurance strategy for PNG must clearly distinguish between the risk management and risk transfer requirements of the large commercial estates and the small and medium semi-commercial farmers who are potentially the targets for agricultural insurance, and the large numbers of subsistence farmers who operate small-scale family gardens for food consumption purposes and for whom conventional individual farmer agricultural insurance has little or no use. There is a major challenge to design appropriate risk management programs for subsistence farmers. For the category of subsistence farmer, this report argues that some form of macro-level weather index insurance (WII) may have a role to play in securing food supplies in times of severe crop failure due to ENSO-El Niño droughts in PNG.

8. ***There is no tradition of agricultural insurance provision in PNG.*** To date no commercial insurance company in PNG has underwritten any crop or livestock insurance policy. The general perception among the interviewed insurance companies is that agricultural insurance is a risky business. However, under certain preconditions including: (a) existence of an accurate risk assessment for the agricultural sector, (b) the existence of a training program for their underwriters on agricultural insurance, and (c) full reinsurance protection, , (d) support from government in sharing costs in the start-up phase, they may consider entering into the agricultural insurance business on a pilot basis.

9. ***Farmers have limited awareness of agricultural insurance***. In the absence of any agricultural insurance provision in PNG, most farmers have no knowledge or awareness or experience of crop or livestock insurance and the potential benefits and constraints of such products. In the absence of a functioning agricultural insurance market, it is difficult to quantify objectively farmers' potential demand for these products. The starting point of any future more detailed feasibility study should be to conduct a formal demand assessment survey. This survey should also examine the demand by the commercial oil palm (and other cash crop) companies for insurance on their commercial tree crop estates; to date it appears that the demand for agricultural insurance by the estate sector is low.

10. ***Lack of a national framework for agricultural insurance***: There is currently no clear policy framework for agricultural insurance in PNG. GoPNG is fully committed to strengthening the country's natural disaster prevention measures, and early warning and response systems, but within this context the role of agricultural insurance has not yet been identified and this also applies to the potential supporting roles government might play in the start-up phase of any new agricultural insurance program. There is a need for GoPNG to provide a clear statement on its objectives for agricultural insurance and the priority types of farmer and priority crops and livestock to be insured.

11. ***There may be a need to amend the insurance regulatory framework to support the introduction of agricultural insurance in PNG.*** The Insurance Commission has indicated its

strong support for the introduction of agricultural insurance into PNG. The Insurance Commission will need to decide whether the introduction of agricultural insurance will require any changes to the existing Insurance Act 1995 and whether or not the special case of index-based agricultural insurance is authorized in PNG[1].

12. ***Coordination of Agricultural Insurance with existing Natural Disaster Programs***. If agricultural insurance cover is to be introduced into PNG in future, it will be necessary for GoPNG to review the role and purpose of agricultural insurance in relationship to the existing natural disaster relief and compensation programs (e.g. in the form of food aid following major drought and or tropical cyclone and flood events) to small rural households. If insurance and disaster relief payments are made to farmers this would amount to a double indemnity. International experience shows that where free public-sector disaster relief is provided this acts a major disincentive for farmers to purchase crop insurance. One option may be to replace the ad hoc disaster compensation payments made by government following major drought events with an ex-ante macro (government) level national food security rainfall deficit insurance program (discussed further below).

Technical Challenges

13. ***Data and information are critical to the assessment of risk in agriculture and to the design and rating of any crop and livestock insurance products and programs***. There are, however, major data constraints in PNG. The Department of Agriculture and Livestock (DAL) does not conduct annual surveys of crop planted area, harvested area, production and yields and furthermore it not systematically record crop damage by natural or climatic perils. As such time series data are lacking for all food crops. In the case of the major export commodities, national export production figures are available for many years, but planted area data are not available for most export crops and in this case data are not available at Provincial and District levels. This lack of crop production data has severely limited the amount of risk assessment that could be conducted under this study and is also a constraint to the design and rating of any form of traditional yield-based crop insurance product or program. Within these constraints, however, named-peril damage-based crop insurance products for tropical cyclone (plus allied perils) for export crops could be considered.

14. ***Livestock production in PNG is segmented into a few commercial cattle, pig and poultry enterprises and then large numbers of subsistence farmers who own a few pigs sheep and goats and poultry for family consumption purposes***. The DAL does not collect and maintain livestock holding data and livestock mortality data-bases and this again severely restricts the ability to assess the potential for designing, rating and introducing any form of livestock insurance into PNG.

15. ***Accurate time-series meteorological weather data is a basic input needed to design weather-index insurance (WII) products***. However, there are currently very few operative weather stations in PNG that can provide time-series uninterrupted rainfall and temperature data

[1] Article 2 Interpretation defines "General insurance business" as: (a) business of undertaking liability by way of insurance (including re-insurance) in respect of any loss or damage, including liability to pay damages or compensation, contingent on the happening of a specified event and (b) any business incidental to general insurance. The act does not make any specific mention of either agriculture as a class of insurance business or index insurance as a type of insurance product, and therefore there is currently nothing in the Insurance Act to prevent the introduction of both conventional indemnity-based and index-based agricultural insurance products. Any new insurance product or policy has first to be approved by the Insurance Commissioner.

to design and rate individual farmer WII products. In the absence of an adequate density of ground-based weather stations in PNG, the potential of developing macro-level satellite rainfall crop insurance products is explored in this report. Finally it is noted that there is a very good historical data-base of Tropical Cyclone events for PNG and this data affords the potential to design and rate either traditional indemnity based and/or index-based catastrophe windstorm crop insurance cover in PNG.

16. ***A major World Bank and Asian Development Bank (ADB) financed technical risk assessment and risk modeling exercise has recently been concluded for earthquake and tropical cyclone in PNG*** under the Pacific Risk Assessment and Financing Initiative (PCRAFI). The results of this exercise will be invaluable to the future design and rating of Tropical Cyclone cover for cash crops (oil palm etc).

Financial Challenges

17. ***Farmers' constraints and low capacity to afford agricultural insurance.*** On the basis of the limited field work with panels of coffee and oil palm producers, it appears that semi-commercial smallholders in PNG have very limited financial resources. Many of these farmers face constraints such as a lack of access to production credit to purchase inputs and poor access to markets (which is accentuated by the poor communication and transport systems) and low prices for their output[2]. For these farmers crop insurance is a low priority which they cannot afford. If individual farmer (micro-level) crop insurance is to be introduced into PNG it will first be necessary to conduct a formal farm-level survey which should address farmers' demand for crop insurance and their ability to pay premiums for different coverage and premium rate levels.

18. ***Private commercial insurance companies in PNG have limited financial capacity*** and seem to be, in general, reluctant to invest in agricultural insurance, which is considered to be a high-risk class of insurance. Commercial insurers are also concerned about the access to international agricultural reinsurance capacity to reinsure these types of risks.

Operational Challenges

19. ***Private commercial insurers do not have rural branch networks to underwrite agricultural crop and livestock insurance policies for smallholder producers***. The lack of rural branch networks leads to high transaction cost in delivering agricultural insurance, in particular, for small and marginal farmers. There is therefore a need to explore opportunities to deliver agricultural insurance cost effectively through existing rural institutions in PNG which have direct access to smallholders. In PNG these rural institutions are likely to include the Nucleus Estate and Smallholder NES system whereby smallholder producers of export cash crops (oil palm, cocoa, rubber and to a lesser extent coffee and coconuts) are contracted by the estates to produce and supply the export commodity and possibly the MFIs including PNG Microfinance Ltd which is providing smallholders with loans to replant their oil palm as part of the World Bank financed Smallholder Agricultural Development Project (SADP).

20. ***Lack of exposure to international agricultural insurance practice***: The private insurance companies in PNG have had little exposure to international practice in agricultural insurance. They lack knowledge and awareness in the design, rating, and implementation of agricultural insurance. If an agricultural insurance market is to be developed in PNG, specialist technical assistance will be required to assist the PNG Insurance Association and Insurance

[2] See for example Hansen et al., 2001.

Commission to design and rate and prepare policy wordings for these new agricultural insurance products.

Crop and Livestock Insurance Product Opportunities for PNG

21. ***On the basis of the pre-feasibility study it is apparent that the potential to develop crop and livestock insurance products and programs is currently fairly restricted in PNG*** by a number of factors including lack of an agricultural insurance culture and functioning market, lack of demand especially by small mainly subsistence farmers, and the lack of crop production, crop damage and weather data on which basis to design and rate such programs.

22. ***The study has, however, identified a series of potential traditional indemnity-based and/or parametric or index-based crop insurance products for the cash crop/plantation export crops and food crop sectors that might be developed in PNG***. These products include individual grower (micro-level) insurance products and macro-level products that are designed to insure GoPNG against catastrophe climatic events. A summary of the potentially suitable crop insurance products is shown in the table below.

Table 1. Suitability of Traditional Indemnity-based and Index based Crop Insurance Products for Papua New Guinea

Type of Crop Insurance Product	Basis of Insurance & Indemnity	Suitable for PNG?
A. Traditional Individual Farmer Indemnity Insurance		
1. Single peril (e.g. Tropical Cyclone, Wind)	% Damage	POSSIBLY outgrower schemes for oil palm and rubber
2. Named Peril (e.g. Fire, Wind, Volcano)	% Damage	POSSIBLY outgrower schemes for oil palm and rubber
3. Multiple Peril Crop Insurance (MPCI)	Loss of Yield	NO
4. Revenue Insurance	Loss of Yield and Price	NO
B. Innovative Crop Index Insurance		
5. Aggregate Yield Shortfall Insurance	Loss of Aggregate Yield	NO
6. Area-Yield Index Insurance (e.g. India, USA)	Area-Yield Index	NO
7. Crop Weather Index Insurance (WII):	Weather Index (e.g. rainfall)	
7.1. Micro-WII (Individual farmers) (e.g. Malawi)	Weather Index (e.g. rainfall)	NO
7.2. Meso-WII (Financial institutions, input suppliers)	Weather Index (e.g. windstorm, hurricane)	POSSIBLY – outgrower schemes for oil palm
7.3. Macro-WII (Government) (e.g. Malawi, Ethiopia)	Weather Index (e.g. rainfall)	POSSIBLY using satellite rainfall – see Product 8.
8. Remote Sensing Indexes (e.g. Satellite Rainfall index; NDVI/drought pasture indexes for livestock, Satellite Imagery or Synthetic Aperture Radar, SAR, for Flood)	Remote Sensing Index (e.g. Satellite Rainfall Index)	POSSIBLY National drought insurance scheme for food security

Source: Authors based on survey findings.

23. ***It may be technically feasible to design a named peril damage-based policy for windstorm Cover (plus allied perils e.g. fire, volcanic eruption) in tree crops including oil palm, rubber and possibly cocoa***. This product would be targeted at smallholder producers linked to the nucleus estates. The main technical challenge for this product will be the availability or otherwise of historical crop windstorm and fire damage data at a disaggregated (preferably individual farmer) level in order to set the deductibles and rates on this product. If necessary a special survey will have to be conducted to quantify the historical windstorm losses in these crops. The main operational challenge for this cover will be how to market and distribute this product cost-effectively to smallholder out-growers in PNG and also to design and implement low cost in-field damage-based loss assessment procedures.

24. ***Options may also exist for designing and rating a Tropical Cyclone Index for cash crops of oil palm, rubber and cocoa.*** There is a lengthy record of more than 50 years of tropical cyclone data on which basis to design and rate such a product. The main challenge, however, if this product is offered as an individual farmer micro-level policy is likely to be basis risk. For this reason this product might be more suited to a macro-level ex-ante emergency relief product for GoPNG.

25. ***Finally, options may exist to develop a Macro-level satellite rainfall deficit food security cover*** to provide contingency payments to GoPNG in years of severe ENSO El Nino drought related food shortages such as occurred in 1997/98. To date, several countries including Ethiopia, Malawi and Mexico have designed macro-level rainfall deficit index insurance covers that have been designed to provide governments with immediate cash liquidity following a natural disaster and to enable the government to provide an early response. In PNG there appears to be considerable scope for using a macro-level rainfall deficit insurance cover as a social safety net product for small subsistence farmers located throughout the country for whom commercial crop insurance is not necessarily an appropriate or cost-effective mechanism.

26. ***In the short term, options for livestock insurance in PNG appear to be very limited, at least for the smallholder sector***. There may, however, be opportunities for commercial large-scale pig and poultry producers to seek facultative (case by case) insurance cover from the local insurance industry.

Institutional and Operations Considerations

27. ***It is likely that the development of any market-based crop insurance products and programs in PNG will require the active collaboration by the private and public sectors under some form of private-public partnership agreement, PPP***. The private commercial insurers do not have the resources to invest in agricultural insurance by themselves and the will need assistance from government and other public and private institutions to establish suitable insurance infrastructure. One major challenge is therefore to define an appropriate agricultural insurance strategy relying on strong public-private partnerships which would include both the private commercial insurers and the Banks/MFIs and other rural service organizations including the export tree crop sector which operates a nucleus estate and smallholder (NES) production model. An institutional framework for an agricultural insurance PPP in PNG is presented in this report.

28. ***This report provides a review of international experience with public, private and PPP agricultural insurance schemes and the roles that governments can play in supporting the introduction of agricultural insurance***. Under start-up situations, such as in PNG, where there is currently no agricultural insurance supply, government can play a very important role in creating a suitable legal and regulatory environment and in investing in agricultural insurance

infrastructure including: providing insurers' with access to crop production and weather data and statistics, financial support for the creation of a Technical Support Unit to conduct feasibility studies for the design and rating of agricultural insurance programs, investment in increasing the density of automated weather stations through to assistance in the design and training of field-based loss assessment systems and procedures for windstorm and allied perils. Under some circumstances, government's may also provide financial support either in the form of reinsurance of catastrophe claims and or the provision of premium subsidies which are designed to reduce the costs of premiums to farmers, thereby making agricultural insurance more accessible and affordable especially for small and marginal farmers. This report recommends that GoPNG should be very cautious about offering premium subsidies unless these are carefully targeted and budgeted. One exception would be in the case of a meso-level satellite rainfall index product where GoPNG would be the insured and would be responsible for paying premiums.

29. ***The potential benefits of forming a local coinsurance pool to underwrite the proposed crop insurance program are reviewed in this report.*** In emerging economies where this is no tradition of crop or livestock insurance or rural insurance infrastructure, a pool coinsurance program may be a much more attractive and cost-effective proposition for commercial insurance companies than if they were to try to operate independently.

30. ***The potential to bundle agricultural insurance with credit provision and input supplies should be considered in PNG.*** The bundling of crop insurance with credit and input supplies has been shown in many parts of the world to provide a win-win for farmers, credit providers and insurers. The farmer gains access to seasonal crop credit, lending institutions are more willing to lend to small farmers because their loans are protected by crop insurance and finally the insurer benefits from (a) anti-section is reduced, (b) there is less need for pre-inspections (c) the costs of promoting and marketing the agricultural insurance program are reduced and (d) the insurance uptake and spread of risk and premium volume is generally much higher than under a purely voluntary program. In PNG there may be opportunities to link windstorm crop insurance for oil palm producers with replanting loans provided to these farmers by PNG Microfinance Ltd under the SADP.

Next Steps

31. ***The Pre-feasibility study will be submitted to the Department of Agriculture and Livestock (DAL), GoPNG for review***. It is recommended that the report should also be made available to all interested potential stakeholders from the public and private sectors.

32. ***Depending on the outcomes of GoPNG's review of this report, the next stage would be to implement a full feasibility study for agricultural insurance*** which would be designed to address some of the key outstanding issues identified by this initial study including to:

(a) Conduct a formal individual ***crop insurance demand study*** with smallholders involved in cash crop production under the nucleus estate, outgrower schemes for oil palm, rubber and cocoa sectors;

(b) Investigate further the potential to develop a ***public-private partnership*** for agricultural insurance in PNG and the respective roles of government and the private commercial insurance companies;

(c) Investigate further the technical design and rating requirements and operating systems and procedures ***for named peril damage-based tropical cyclone cover in oil palm, rubber and cocoa***. Under this study it would be necessary to implement a survey of the targeted farmers to collect time series information of tropical cyclone (and allied perils – e.g. fire) damage to their oil palm plantations,

(d) Investigate further the technical design and rating requirements and operating systems and procedures for an alternative ***Index-based cover for tropical cyclone only cover in oil palm, rubber and cocoa*** which might be offered either as an individual farmer cover or as a macro-level emergency relief cover for government. This study would need to examine closely the issues of basis risk if individual farmer (micro-level) cover is to be provided.

(e) To investigate further technical design and rating requirements and operating systems and procedures for a ***macro-level satellite rainfall index*** designed to provide food security at a national level in the event of catastrophe drought.

33. ***Design and Implementation of Crop Insurance Pilots***. If on the basis of the detailed feasibility studies there appears to be sufficient demand for any of the above crop insurance programs in PNG, and the other outstanding technical issues listed above can be resolved, then at that stage, subject to approval by GoPNG and the private commercial insurers, decisions may be taken to move to a planning and design phase for the implementation of a pilot crop insurance program(s).

34. ***Creation of an Agricultural Insurance Committee***. In the short-term, the formation of an agricultural steering committee is strongly recommended to provide a forum of public and private stakeholders to meet on a regular basis in order to plan and coordinate implementation of the detailed feasibility studies. The SC could be coordinated through the existing Office of Climatic Change and Development (OCCD) because of its central role in this area of climate and agricultural risk management.

35. ***Creation of a Technical Support Unit (TSU)***. GoPNG should consider creating an agricultural insurance Technical Support Unit which would assist local public and private stakeholders involved in agricultural insurance on (i) data and information collection and management; (ii) insurance demand assessment; (iii) product design and rating; (iv) the design of operating systems and procedures, most notably underwriting and claims control and loss assessment procedures; (v) training for insurance companies, MFIs, farmer organizations, and farmer groups; and (vi) awareness campaigns. The technical unit would be staffed by two or three agricultural insurance specialists and report to the Steering Committee. The TSU would also act as a focal point for the provision of external technical assistance programs.

36. ***For livestock there appears to be very limited opportunities for developing suitable insurance policies for small holder farmers, but it may be possible in future to develop cover for large commercial pig and poultry operations***. Smallholder livestock production of pigs, sheep, goats and chicken in PNG is practiced on a very small scale in family back yards with very low levels of livestock husbandry, management and sanitary standards. The low levels of livestock husbandry would not meet the minimum standards of insurability set by international reinsurers and the very small scale of operations would preclude insurance cover because of the very high administrative costs involved.

Chapter 1: Introduction and Objectives of the Study

Importance of Agriculture in Papua New Guinea

1.1. ***Papua New Guinea (PNG), located in the Asian-Pacific Region***, occupies the eastern half of the Island of New Guinea and other numerous offshore islands. With a per-capita GDP of US$ 1,382 and 37.5% of the population living below the poverty line in 2010, PNG is classified as a lower middle income country. The country's main exports include minerals, crude oil and agricultural and forestry products.

1.2. ***Agriculture is the predominant source of livelihood in the country***, with the agricultural sector accounting for 67% of the total labour force and 35% of the GDP in 2010. PNG's total population is 7.1 million (2011), of which 87.5% live in rural areas and practice mainly subsistence agriculture[3]. The most important food crops produced are bananas, sweet potatoes, sugar cane, cocoyam, yams and maize. Important cash export crops include oil palm, coffee, cocoa, coconuts (copra and oil) and to a lesser extent rubber and tea. Game meat production and exports is very important, with fish production being particularly strong. Very little cereals are produced in PNG and cereals (mainly wheat and rice) account for nearly 40% of all agricultural imports. Overall, PNG is self-sufficient in many agricultural products, and agricultural exports exceed imports.

1.3. ***Most agriculture in PNG is practiced on a subsistence scale*** with small family mixed farming where sweet potato is the main staple crop (other staple crops include cassava, yams, taro and bananas) and the rearing of small numbers of pigs, chicken and sometimes goats. Severe poverty affects many of these rural households. Cash cropping is also very important in PNG and today the major export cash crops include oil palm, coffee, cocoa, cocoa and coconuts. Traditionally production of these export crops was dominated by large *plantation* estate companies, but today most coffee, cocoa and coconuts are produced by individual farmers (*villagers*) and oil palm is the only major crop where estates continue to account for the bulk of production. Coffee production is concentrated in the highlands and this crop is an important source of cash income for small farmers: cocoa is grown at lower levels on the mainland and the islands, while oil palm is only produced in coastal regions at low altitude.

Exposure of Agriculture to Natural and Climatic Hazards

1.4. ***PNG has a very high exposure to earthquake, tsunami and volcanoes as well as being affected by climatic perils including tropical cyclones and the influence of the ENSO El Nino cycle which brings with it extremes of drought and excess rain and flooding***. PNG is the 51st most exposed country in the world by area to 2 or more natural disasters including earthquake and landslide, volcano, drought, flood and cyclone (World Bank 2005). A recent World Bank/Asian Development Bank (ADB) funded study in the Pacific Island Countries (PICs) including PNG estimated that the annual average costs of earthquakes to the PNG economy amounted to US$ 62. 7 million and that the expected loss to earthquake may be as high as US$ 645 million 1 in 100

[3] FAOSTAT.

years (World Bank 2011)[4]: the direct impact of earthquakes on agriculture remains low but the consequential losses in terms of disrupted transport networks (roads, bridges etc) can be extremely high to the export plantation crop sector and the fresh food sector. In the case of tropical cyclones, PNG lies at the northern extremities of the South Pacific Ocean Tropical Cyclone belt and the estimated average annual loss to agriculture (cash crops) is in the order of US$ 13.5 million per annum (World Bank 2011).

1.5. ***Volcanic eruption*** can impact on agricultural crop and livestock production and the 1994 eruption of Rabaul Caldera (Tavarvur, Vulcan), East New Britain caused devastating destruction of the provincial capital Rabaul and its relocation to Kokopa 20 kilometers away, with total damage to buildings and infrastructure valued at US$ 531 million (Willis 2008). The eruption also caused damage to the local coconut and cocoa industries caused by volcanic ash fallout[5].

1.6. ***Drought and excess rain/flooding are a feature of PNG and are highly influenced by the El Niño (drought) and La Niña (excess rain) phases***. Severe and prolonged drought conditions threaten food and water security. In the 1997-1998 El-Nino which was the most severe El Nino of the 20th century, drought resulted in widespread failure of subsistence food crops, affecting approximately 70% of the rural population, and over PNGK 80M (US$ 37 million) was spent as disaster response. Flooding is also a problem in several of the main river valley areas of mainland New Guinea.

1.7. ***PNG's agricultural sector remains vulnerable to the impacts of climate change***. Sea level rise, temperature rise, higher rainfall and possibly more extreme climatic events have the potential to impact adversely in future on agriculture in PNG. Coastal and inland flooding damage export and subsistence food crops as well as the transportation infrastructure (roads and bridges) needed to bring goods to market, cutting off farmers from their sources of income (World Bank, GRDRR and SOPAC, 2009; Australian Bureau of Meteorology and CSIRO, 2011).

Government Policy for Agricultural Development

1.8. ***The Government of PNG identifies that agriculture has and will continue to be the backbone of the PNG economy*** by providing food, income and employment to the vast majority of the rural population. In recognition that agricultural output had stagnated by the mid-2000s, the Ministry of Agriculture and Livestock drew up a five-year (2007-2011) National Agricultural Development Plan (NADP) which focused on the revitalization of the agricultural crop, livestock and fisheries sectors with a view to creating new and sustainable income earning opportunities for the rural population and to raise incomes and living standards (Ministry of Agriculture and Livestock 2006). The Plan identified the following priority areas: 1) Agriculture research, extension, information and training, 2) Food and horticultural crops development, 3) Tree and industrial crop development, 4) Livestock, apiculture and aquaculture development, 5) Spice and minor crops development, 6) Gender, social and HIV/AIDS related issues, 7) Regulatory and technical services, and 8) NADP management and coordination. Within this plan some of the most important features include the rehabilitation and replanting programs for old oil palm, coffee, cocoa and coconut plantations for small holder production.

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[4] See Annex 1 for further details of the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI)

[5] For a report on Rabaul, see Rabaul, Global Volcanism Program http://www.volcano.si.edu/world/volcano.cfm?vnum=0502-14=&volpage=var#bgvn_1908

1.9. ***The World Bank is actively assisting GoPNG under a series of programs for the export crop sector*** including (i) the Smallholder Agricultural Development Project (SADP), a central component of which is to assist small holders to plant new village oil palm in Oro and West Britain Provinces, to upgrade access roads to the oil palm plantations and to strengthen the extension services available for smallholders (World Bank 2007) and (ii) the Productive Partnerships in Agriculture Project (PPAP) which aims to improve the livelihoods of small cocoa and coffee producers through the improvement of the performance and the sustainability of value-chains (World Bank 2010).

Government Request to the World Bank

1.10. On October 25 2011, the government of PNG and the World Bank signed the Disaster Risk Management and Climate Change Adaptation (DRM/CCA) grant for the Agriculture sector. The grant has three subcomponents, namely (a) Delivery of commodity or crop specific technical studies that analyze the impacts of climate and disaster risks, offer specific policy recommendations and guidelines; (b) Delivery of feasibility study for agriculture risk insurance for smallholder farmers and (c) Delivery of small pilot projects that are able to demonstrate effective risk management and adaptation measures in the agriculture sector. As such, the proposed technical assistance (TA) is to conduct a feasibility study for an agricultural risk insurance program as an integral component of the overall DRM/CCA program in PNG.

Scope and Objectives of the Feasibility Study

1.11. ***The overall objective of the agricultural insurance pre-feasibility study is to assess the viability of market-based agricultural insurance in PNG***. The specific objectives of the study include to

(i) conduct a detailed agricultural risk assessment (major crops and livestock) and weather risk assessment in selected areas;

(ii) identify technical, operational, financial and institutional challenges and possible solutions for the development of commercial agricultural insurance; and

(iii) develop an institutional framework based on a public-private partnership for the development of market-based agricultural insurance in PNG, and particularly the financing of agricultural catastrophic losses.

1.12. A World Bank mission visited PNG between 26 February to 10 March 2012 to undertake the agricultural insurance pre-feasibility study. During this mission the main organizations met included: the Department of Agriculture and Livestock (DAL), the National Agricultural Quarantine & Inspection Authority, the Office of Climate Change and Development (OCCD), the PNG National Weather Service, the Insurance Commission, the Insurance Association and private commercial insurance and insurance broking companies, PNG Sustainable Development Program, the banking sector, Pacific Financial Inclusion Program (PFIP), Remote Sensing Centre, University of PNG, National Agricultural Research Institute (NARI) and the Coffee Industry Corporation (CIC), PNG Cocoa and Coconut Institute (PNGCCI), Oil Palm Industry Corporation (OPIC) and Oil Palm Research Association (OPRA). In addition field visits were conducted to two Provinces, Eastern Highlands and West New Britain in order to meet representatives of the coffee and oil palm sectors and to hold farmer panel meetings with groups of coffee and oil palm producers. The World Bank is very grateful to these organisations for their cooperation and assistance during the conduct of the agricultural insurance pre-feasibility study.

Report Outline

1.13. The remainder of this report is set out in five sections. Chapter 2 presents an overview of agricultural production systems and markets in PNG followed by an assessment of the climatic hazards and other risks affecting the plantation and food crop sectors. Chapter three reviews the agricultural insurance opportunities and challenges for the plantation and food crop sectors and for the livestock sector drawing where appropriate on both traditional indemnity-based insurance products and the new range of index solutions. Chapter 4 deals with some of the key institutional planning considerations which will need to be taken into account if agricultural insurance is to be introduced for the first time into PNG including the role of the private insurance companies, the commercial and rural banks and MFIs and farmer institutions and finally the role that government of PNG might play in supporting the introduction of agricultural insurance under a Private-Public Partnership. The final Chapter presents the conclusions of the Pre-feasibility study and briefly considers the next steps for Government of PNG to consider.

Chapter 2: Agricultural Risk Assessment

2.1. ***This Chapter presents a preliminary assessment of the risks associated with food crop and cash crop production and livestock production in PNG and the implications for crop and livestock insurance.*** The chapter starts with a review of data availability in PNG for risk assessment purposes. This is followed by an overview of crop production systems in PNG, the main cash export crops and food crops and production and yields and an analysis of the key natural and climatic risks affecting crop production and implications for insurance. This is followed by an assessment of livestock production systems in PNG and the availability of data for risk assessment and insurance purposes. It is stressed, however, that this preliminary work must be followed up by a more detailed risk analysis during any future agricultural insurance program.

Framework for Agricultural Risk Assessment and Data Requirements

Framework for Agricultural Risk Assessment

2.2. ***The key objectives of agricultural crop risk assessment*** include:

- Risk identification and quantification of the key natural, climatic and biological perils affecting crop production in the selected country and regions and to classify these according to their frequency and severity into:
  - Independent risks: e.g. fire and hail which result in localised crop losses;
  - Intermediate risks: e.g. excess rain, frost;
  - Highly correlated (systemic) risks: such as drought and flood and windstorm in crops, which have a potential to impact over wide geographical area causing catastrophe losses.
- Risk Mapping to define homogeneous crop risk zones;
- Risk Modelling to quantify the catastrophe exposure to target crops and insured crop portfolios and to aid crop rating decisions;
- To use the outputs of the risk assessment to define a risk financing strategy including insurance and reinsurance structuring for the planned crop insurance portfolio.

2.3. ***The objectives of livestock risk assessment*** closely match those outlined above for crops, although in this case the key perils include both natural and climatic perils (e.g. fire flood, wind, freeze) but also animal diseases including epizootic or epidemic diseases with are highly correlated and which can result in widespread loss as both regional and national levels.

Data Requirements and Limitations

2.4. ***Data for Crop and livestock Risk Assessment***. There are three types of data which are commonly used in the assessment of climatic risk in crop and livestock production including:

(a) **weather data** (rainfall, temperature, wind speed etc) used in the design and rating of traditional indemnity-based and weather index crop insurance products and programs (daily or dekad data is required for a minimum of 20 years or more).

(b) **time-series crop damage and/or production loss data** by cause of loss for each crop and which may also include estimates of the financial value of the damage or losses and in the case of livestock, **livestock mortality statistics** by class of animal and cause of death. (Crop damage data and livestock mortality data are required for as many years as possible and at a district or county level).

(c) **time series crop area, production and yield data**: the analysis of variance in time-series crop production and yield data is commonly used to design and rate individual farmer and area-yield multiple-peril crop insurance, MPCI, programs (minimum 10 to 15 years data at the individual farmer level and at district or county level).

2.5. ***The availability of time-series uninterrupted and up to date weather data is very limited in PNG because very few meteorological stations are currently operating***. In the early 1970's PNG had a very dense network of over 1,100 operating meteorological and agro-climatic weather stations and manual rain gauges, but resource constraints mean that very few of these stations are currently functioning. According to data provided by the PNG National Weather Services (NWS) in 2012, there are only 32[6] weather stations in operation (of which 3 are temporarily closed) out of 1,112 stations (see Annex 2 for further details). It is understood that 14 of the operating weather stations are synoptic weather stations and which are mainly located at airports and that the remaining operating stations are rainfall recording stations. It is not known how many of the 32 operating stations can provide a minimum of 20 years or more of uninterrupted daily weather data for key variables such as rainfall and temperature. This means that on average there are less than 2 weather stations for which data is available across PNG's 19 Provinces and because of the mountainous topography and localized influences on climate that the available weather station data is of very limited use for agricultural risk assessment purposes. In addition to the NWS operated stations, several of the plantation estates manage their own private weather stations and can apparently provide long-term historical daily data dating back 20 or more years. It is also noted that the Remote Sensing Centre, University of PNG in association with Digicel the mobile operator with funding from the European Union (EU) has recently established the Climate Monitoring Network for PNG and in 2012 a total of 19 fully automated weather stations have been installed in all of the mainland provinces to provide real-time weather data and over time to develop an accurate data base of climate for PNG[7] (See Annex 2. for full details of these new weather stations).

2.6. ***The lack of historical weather data restricts the level of crop weather risk assessment that can be conducted for PNG***. Furthermore the very low density of weather stations/lack of uninterrupted historical rainfall data severely restricts the use of such stations for the design and rating and operation of any future weather index insurance (WII) program. Conversely, the more recent development of satellite based rainfall simulation techniques to constructed gridded historical rainfall datasets means that there may be potential in PNG to explore satellite based rainfall index insurance products (See Chapter 3 for further details).

2.7. ***In the case of Tropical Cyclone (TC) data, there is however, a very comprehensive record of individual events that have affected PNG for more than 50 years.*** This chapter contains a preliminary assessment of the frequency and severity of TC's and their impact on agriculture and then Chapter 3 examines the feasibility of developing both indemnity based and

[6] In 2010 it was reported that the PNG NWS operated 14 synoptic stations plus a network of 57 rainfall gauges and in addition a 4-station synoptic network for measuring sea level and sea temperature and finally a SEAFRAME station on Manus Island for sea-level and climate monitoring (World Bank 2010).
[7] See http://www.pngclimate.net for further details.

index based TC crop insurance products for specific crops in PNG. In addition a recent very detailed TC risk assessment and risk mapping exercise has recently been completed for PNG under the World Bank financed Pacific Catastrophe Risk Assessment and Financing (PCRAFI) initiative and the results of this exercise will be invaluable for the future design and rating of any possible TC insurance program for agriculture in PNG. (See next section for further details).

2.8. ***In PNG the DAL does not have any formal system for monitoring and recording of cultivated area, production and yields for food crops and cash crops***. There are therefore no records for small holder food crop production in PNG. In the case of cash crops such as oil palm, coffee, cocoa and coconuts, the national corporations maintain accurate estimates of crop production and exports, but are not able to provide detailed information on cultivated areas in each district and province. As such it is not possible to establish average per hectare yields either for food crops or for plantation tree crops in PNG in order to analyse annual variation in yields in relation to climatic and other variables. Furthermore DAL does not systematically record crop damage for major natural and climatic events. Some analyses are contained in this report based on FAO estimated national crop production statistics for PNG over the past 50 years along with industry level production data for export cash crops.

2.9. ***The lack of historical crop production and yield data and crop loss data, has restricted the amount of crop production risk assessment that can be conducted for PNG.*** Furthermore the lack of historical crop production and yield data means that it will be very difficult to design either individual farmer or area-based loss of yield MPCI insurance products and programs in PNG.

2.10. ***The DAL does not maintain a national database for livestock and it does not record animal mortality data***. The only national livestock data available for this report comes from a 2002 study. The National Agricultural Quarantine & Inspection Authority of the DAL has in recent years made major attempts to strengthen its disease monitoring and reporting: since 2008 the unit has regularly reporting any suspected outbreak of epizootic diseases to the World Organisation for Animal Health (OIE) and data can be downloaded for this period from the OIE website[8]. As in the case of crops, the lack of livestock numbers data at local (provincial and district levels) coupled with the lack of mortality data has severely restricted the risk analysis that could be conducted under this study. Some limited analyses have been conducted on FAO time series data for major livestock classes.

Agricultural Risk Mapping and Assessment studies conducted in PNG

2.11. ***In PNG there is a long history of GIS[9]-based agricultural land use mapping and much of the GIS data-base information provides a source for agricultural risk mapping***. The first of these systems, the Papua New Guinea Resource Information System (PNGRIS) was developed in the early 1980s. PNGRIS is a national data-base of natural resources, land use and population distribution for PNG which is available in GIS maps at a scale of 1:500,000. It uses Mapinfo (version 4.5) and manages the data using FoxPro database management software. PNGRIS data is organized into discrete mapping units termed “Resource Mapping Units” RMU’s based on the following key attributes: landform, rock type, altitude, relief, mean annual rainfall, inundation (susceptibility to flooding), province. A total of 4,566 RMU’s were identified under PNGRIS for PNG. PNGRIS also contains information on population (1980 and 1990 census data) and vegetation, soils, rural population, land use and land use intensity and constraints to agriculture

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[8] http://web.oie.int

[9] GIS = Geographical Information Systems

(Bellamy and McAlpine 1995). Much of this information is extremely useful for the purposes of agricultural risk mapping and the definition of homogeneous risk zones. The main drawback of PNGRIS is that it does not include any up to date information on agricultural cropped area by crop type or livestock holdings by class of animal for the 4,566 RMUs. The second major source of information for PNG is the Mapping Agricultural Systems of PNG (MASP) database. The primary objective of MASP was to produce information on smallholder agriculture at provincial and national levels. Fieldwork was conducted for the whole country between 1990 and 1996 and a total of 287 discrete agricultural systems were identified and the data mapped in Mapinfo GIS software at a scale of 1:500,000 (Hobsbawn et al, 1997; Bourke et al 1998). The MASP system can generate information at provincial level on the dominant and sub-dominant staple crops, fruit, vegetable and nut crops and cash crops (cocoa, coffee oil palm etc) and in theory could be used to provide estimates of cultivated areas for each dominant crop type. PNGRIS was most recently updated in 2007, but the underlying database has not however, been updated since 1996 (Bryan & Shearman, 2008).

2.12. ***In PNG, the most relevant agricultural risk assessment work for insurance purposes was completed recently under the joint World Bank / Asian Development Bank[10] implemented Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI***). Under Phase I of this initiative a major risk assessment exercise was completed for eight of the fifteen Pacific Island countries namely the Cook Islands, Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu and country risk profiles for typhoon (and storm surge, flood and rain) and earthquake and tsunami have been prepared.[11] Second generation hazard and risk models have now been prepared for all 15 countries. The results of this major risk mapping and risk assessment exercise will be used to develop risk transfer and risk financing options to cover the costs of these natural disasters under the proposed Pacific Disaster Reserve Fund. In the case of PNG, two very useful research documents have been provided under PCRAFI (i) Papua New Guinea Country Assessment (World Bank 2010a) and Country Risk Profile: Papua New Guinea (World Bank 2011) and the results of these documents are reviewed in relevant sections of this report. Under PCRAFI a very detailed risk assessment and risk mapping exercise has been conducted for tropical cyclone (TC) in PNG based on a detailed analysis of 60 years TC event data and development of a state of the art model to simulate expected frequencies and severities and damage impacts. It had been hoped to obtain original TC data and agricultural risk exposure data from SOPAC in order to include this in the current report, but the data is not yet accessible. It will, however, be a very important source of information in the future development of any type of Tropical Cyclone indemnity-based or index-based insurance cover for agriculture in PNG.

Agricultural Production Systems in Papua New Guinea

2.13. Mainland PNG comprises the eastern half of New Guinea and a series of 600 smaller islands lying to the east of New Guinea the largest of which include New Britain, New Ireland and Bougainville. The mainland is dominated by a rugged central mountainous belt rising to over 4,500 metres, several wide valleys and a low-lying palm mangrove coastline dissected by the many rivers flowing from the mountains. (Figure 2.1).

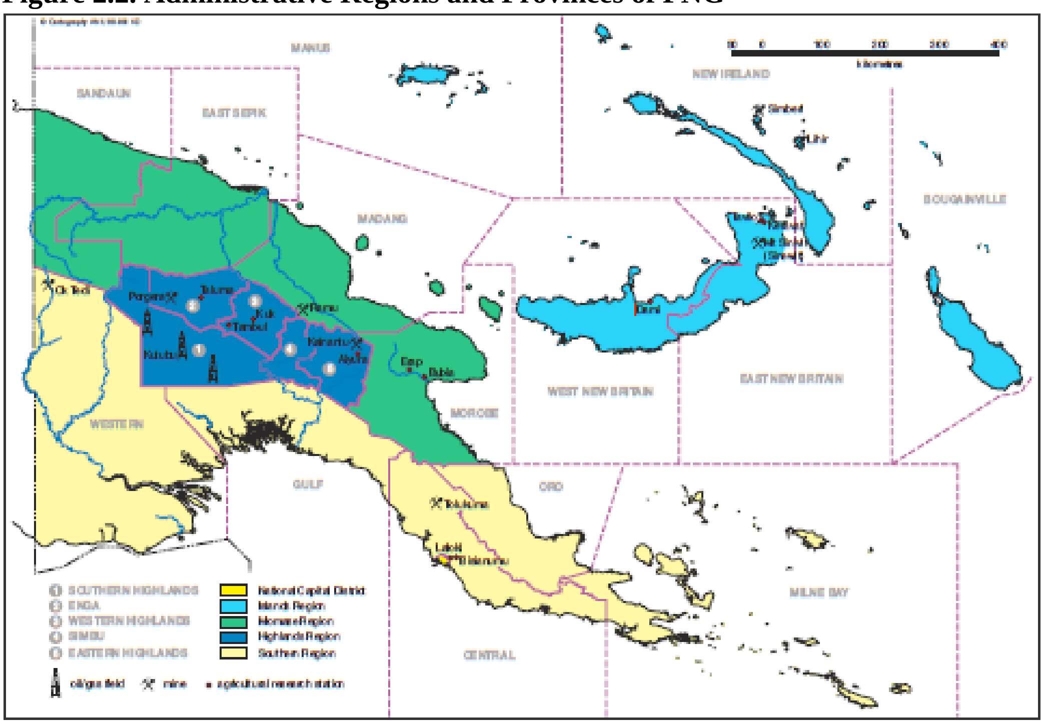
[10] This initiative was co-funded by the Global Fund for Disaster Risk Reduction, GFDRR and the Government of Japan.
[11] Copies of the Country Risk Profiles for these countries can be downloaded from http://go.worldbank.org/7BXXDUVMC0

Figure 2.1.Topographical Map of Papua New Guinea

Source: Wikipedia

2.14. The country is divided into 5 regions, the National Capital District, Highlands, Islands, Momose, and Papua and 19 administrative Provinces and the national capital Port Moresby. Each Province is further divided into Districts (total of 85), beneath which, the lowest level of administration is the Local Level Government (LLG). (See Map in Figure 2.2.)

Figure 2.2. Administrative Regions and Provinces of PNG

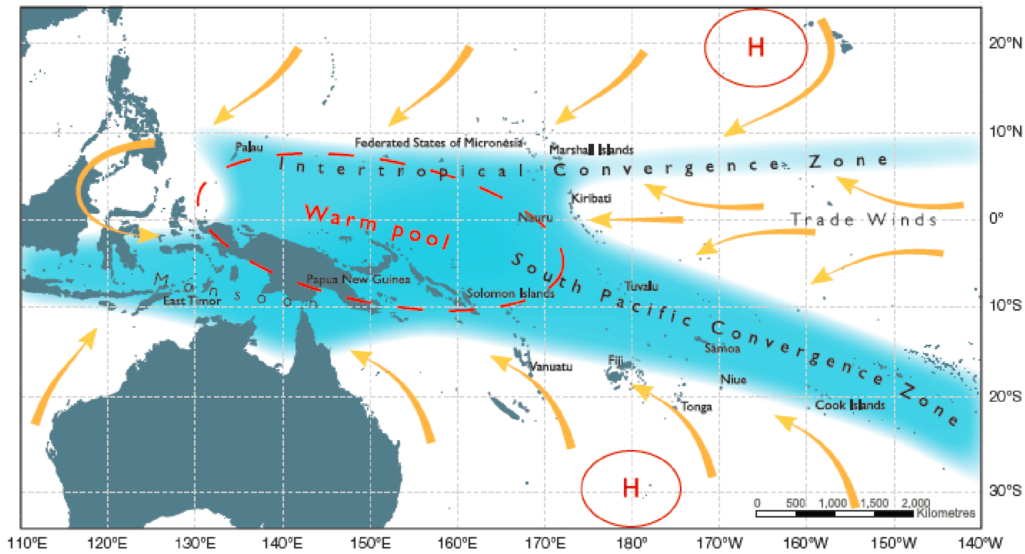


Source: Bourke and Harwood 2009

Climate (Rainfall and Temperature)

2.15. ***PNG is located between 5 degrees and 10 degrees south of the equator and enjoys a monsoon type climate***. PNG's rainfall and temperature are influenced by three large scale wind convergence and rainfall regimes: the Inter-Tropical Convergence Zone (ITCZ), the South Pacific Convergence Zone and the West Pacific Monsoon (WPM) West Pacific Monsoon (Figure 2.3.).

Figure 2.3. Influence of West Pacific Monsoon, South Pacific Convergence Zone and Intertropical Convergence Zone on PNG's Rainfall and Temperature

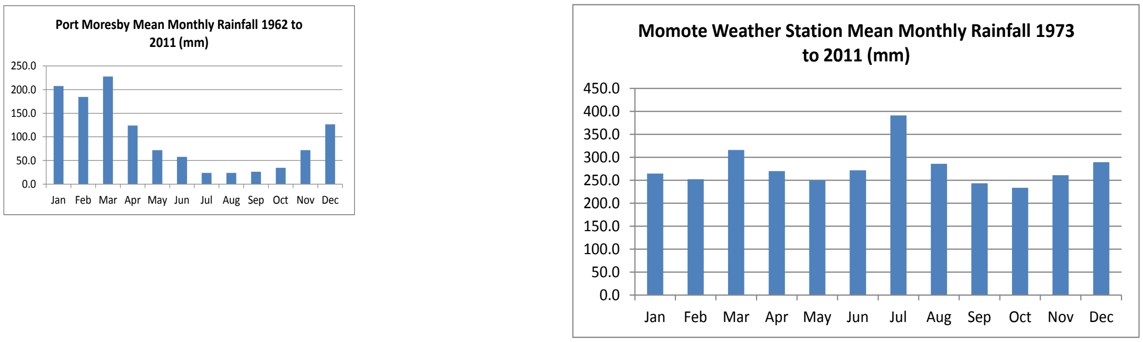


Source: Australian Bureau of Meteorology and CSIRO, 2011.

2.16. ***There is a marked decreasing rainfall gradient from north to south*** in PNG: annual average rainfall recorded in the far north at Momote airport, Los Negros, Admiralty Islands is an average 3,312 mm per annum compared to only 1,179 mm per annum at Port Moresby located on the southern coast of New Guinea. The highest average rainfall of over 7,000 mm is recorded in Ok Tedi in the far northwest of Western Province bordering Indonesia. Very high rainfall is also experienced in northern Gulf Province and along the south coast of New Britain and south coast of Bougainville Island (Bourke & Harwood, 2009).

2.17. ***The southern region of PNG tends to experience a marked rainy season from January to April followed by a dry season from May to October***. At Port Moresby nearly two thirds of annual rainfall is distributed between January and April, and less than 50 mm of precipitation are recorded between July and October: conversely rainfall at Momote weather station in the far north is much more evenly distributed throughout the year with no dry season. (Figure 2.4).

Figure 2.4. Comparison of Mean Monthly Rainfall at Port Moresby and Momote Stations

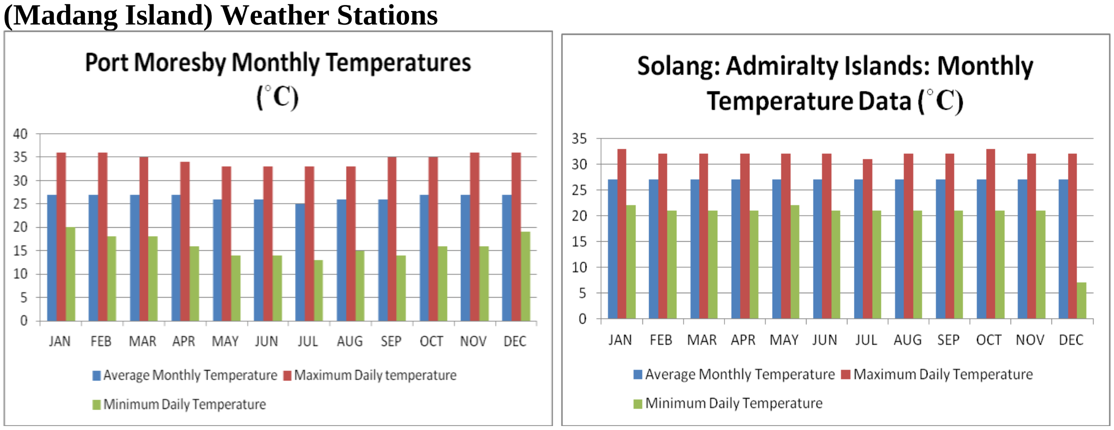


Source: PNG National Weather Service

2.18. ***Due to its proximity to the equator average daily temperatures in PNG are very stable throughout the year without any marked seasonality***. Mean daily temperatures at Port Moresby (southern PNG) are 27˚C and show very little variation throughout the year: similarly average daily temperatures at Solano, Admiralty Islands (far north) are 27˚C. (Figure 2.5.).

2.19. ***The high annual average rainfall and high average temperatures mean that crops can be grown throughout the year in PNG.***

Figure 2.5. Comparison of Average Monthly Temperatures at Port Moresby and Solang (Madang Island) Weather Stations



Source: http://www.weatherbase.com

Land Use

2.20. ***About one third of all land in PNG is suitable for agriculture, but currently only about 2.5% of total land area is cultivated (annual and permanent crops) and two thirds of the country is covered by forests***. Information on land use in PNG comes from a variety of sources. PNGRIS results based on 1975 data suggested that of the total land area of 459,854 km², 319,531 Km² or 69.5% of total was unused (original forest), and the remaining 30.5% of used land was divided into cultivated land, 177,858 km² (25.6% of total) and uncultivated grasslands and savannah land 22,465 km² (4.9% of total): however, only about 10,839 km² or 2.4% of total cultivated land use was classified as high and the provinces with the largest areas of cultivation included Madang and Morobe provinces. (Bourke and Harwood 2009). FAO advise total area of 452,900 km² of which arable land accounts for 0.6% of total area, permanent crops (1.5%) and forest cover 63.7% in 2009 (FAOStat). Finally, the Commonwealth Year Book (2011) states that

PNG has a total land area of 662,840 km² of which forest covers 64% of the land area, having declined at 0.5% per annum between 2000 and 2007, arable land comprises 0.6% and permanent cropland 1.3% of the total land area. (The Commonwealth Year Book 2011).

Main Food and Cash Crops grown in PNG

2.21. There are approximately 1.35 million hectares of major crops grown in PNG with an estimated replacement value of US$ 3,061 million (World Bank 2010).

2.22. ***The DAL does not maintain statistics on agricultural crop production and therefore the estimates presented in this report are based on a combination of (i) FAO statistics especially for food crops and (ii) industry statistics for plantation export crops (cash crops)***. In 2009 the value of the top 20 agricultural commodities produced in PNG were valued at US$ 2.5 billion with nearly 82% of this value contributed by mainly subsistence food and livestock production and 18% generated by permanent cash crops (FAOStat 2010). The top five commodities by value of production were game meat (26.3%), fresh fruit (13.7%), bananas (12.0%), berries (9.3%) and then oil palm (8.2%). (Table 2.1 and Figure 2.6).

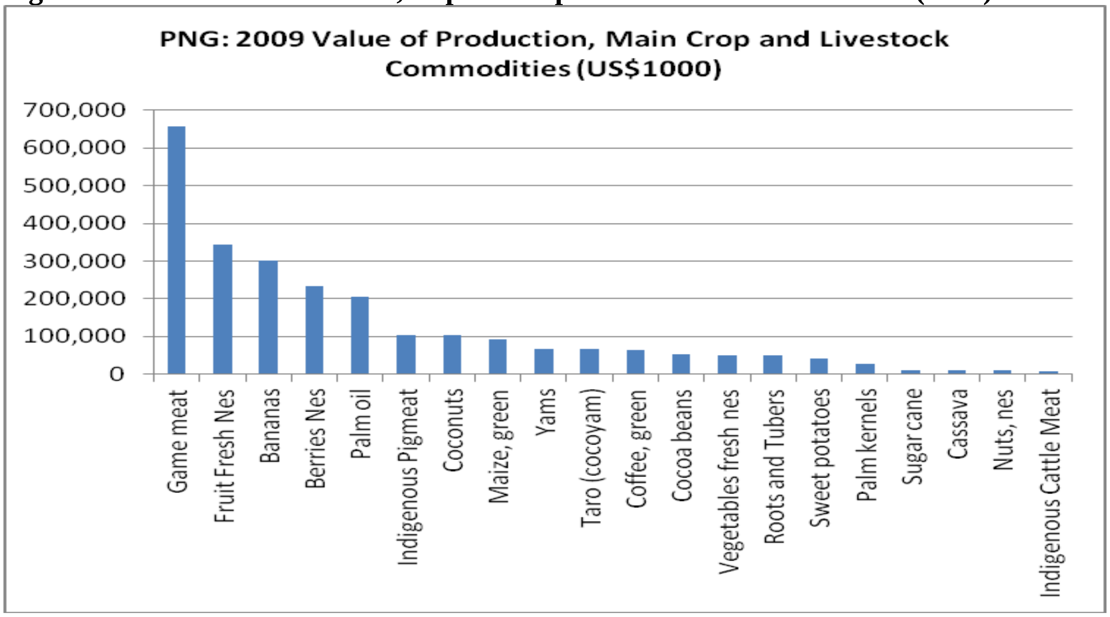
Table 2.1. PNG Agricultural Crop and Livestock Production – top 20 commodities

Rank	Commodity	2009 Value of Production (US$1000)	% of Value of Production	2010 Area Harvested (Ha)	2010 Average Yield (MT/Ha)	2010 Production (MT)
1	Game meat	656,706	26.3%			
2	Fruit Fresh Nes	343,285	13.7%	112,000	8.46	947,800
3	Bananas	300,871	12.0%	65,600	20.21	1,325,700
4	Berries Nes	232,825	9.3%	23,500	5.48	128,800
6	Indigenous Pigmeat	104,532	4.2%			
8	Maize, green	93,361	3.7%	20,400	11.28	230,100
9	Yams	66,861	2.7%	19,900	18.33	364,700
10	Taro (cocoyam)	66,556	2.7%	47,200	5.74	271,100
13	Vegetables fresh nes	50,774	2.0%	15,100	18.20	274,800
14	Roots and Tubers	50,501	2.0%	22,500	14.16	318,500
15	Sweet potatoes	40,338	1.6%	123,400	4.67	576,000
18	Cassava	10,447	0.4%	10,100	12.09	122,100
19	Nuts, nes	10,266	0.4%	10,000	0.56	5,600
20	Indigenous Cattle Meat	8,671	0.3%			
Sub-Total Subsistence Food Crops + Livestock Products		**2,035,994**	**81.5%**	**469,700**	**119.17**	**4,565,200**
5	Palm oil	204,477	8.2%	119,000	14.54	1,730,000
7	Coconuts	102,833	4.1%	220,000	4.10	902,000
11	Coffee, green	64,719	2.6%	55,000	1.22	67,200
12	Cocoa beans	52,963	2.1%	128,000	0.44	56,800
16	Palm kernels	27,619	1.1%			
17	Sugar cane	10,508	0.4%	8,500	37.65	320,000
Sub-Total Plantation Cash Crops		**463,119**	**18.5%**	**530,500**	**57.95**	**3,076,000**

Total Food and Cash Commodities	**2,499,113**	**100.0%**	**1,000,200**	**7.64**	**7,641,200**

Source: FAOSTAT

Figure 2.6. Value of Production, Top 20 Crop and livestock commodities (2009)



Source: FAOSTAT

Estate vs Smallholder Farming Systems of PNG

2.23. ***There are two distinct subsectors in PNG agriculture, the large commercial estates and the smallholder farmers many of whom are involved in subsistence agriculture.*** The large estates hire labour and are predominantly involved in the production of plantation tree crops for export including coconuts, cocoa, coffee, oil palm and minor crops such as rubber and tea. The expansion of the estates has been restricted by the customary land tenure system in PNG: under this system land is owned by the clans and land use rights may be granted to individual families or even companies; however, land transfer or sale is not permitted by the clans. Smallholder farmers are also actively involved in the production of these export tree crops. Indeed over time the share of production of coconuts, coffee and cocoa has shifted almost entirely away from the estates to the smallholder farming sector and only in the case of oil palm is the bulk of production in the hands of 5 large nucleus estates which maintain out-grower programs. Rubber is also an important crop grown mainly in Western Region, including an innovative small farmer program, the North Fly Rubber Limited project. (Annex 3. presents a review of the production of the major export tree crops including coffee, cocoa, coconuts, oil palm and rubber, drawing on FAOStat data and a major recent 2009 study on Food and Agriculture in PNG by Bourke and Harwood 2009).

2.24. ***Shifting bush fallow cultivation practices have been used by the subsistence-based agricultural communities in PNG for many thousands of years***. Farmers commonly plant small gardens of 0.1 to 0.5 Ha to grow food crops to meet their household consumption requirements: crops may be planted singly in each garden crop, or intercropped. These gardens are surrounded by virgin forest or fallow land and land which is in some stage of re-growth. Land is typically fallowed for about 5 to 15 years. Due to high rainfall intensity and problems of soil saturation and waterlogging, gardens are typically located on sloping land and the soil is ridged into mounds into which the crops are planted by hand. There are 4 main farming systems, (1) sago and taro-based systems in wet lowlands, (2) yam, banana and cassava based systems in the dry lowlands, (3) taro and sweet potato based systems in the highlands and its fringes, and (4) sweet potato and Irish potato systems in the high altitude valleys. Smallholder cash incomes come from production and sales of export trees crops (oil palm, coffee, cocoa, coconuts), fresh food, fish, betel nut etc (Gwaiseuk 2000).

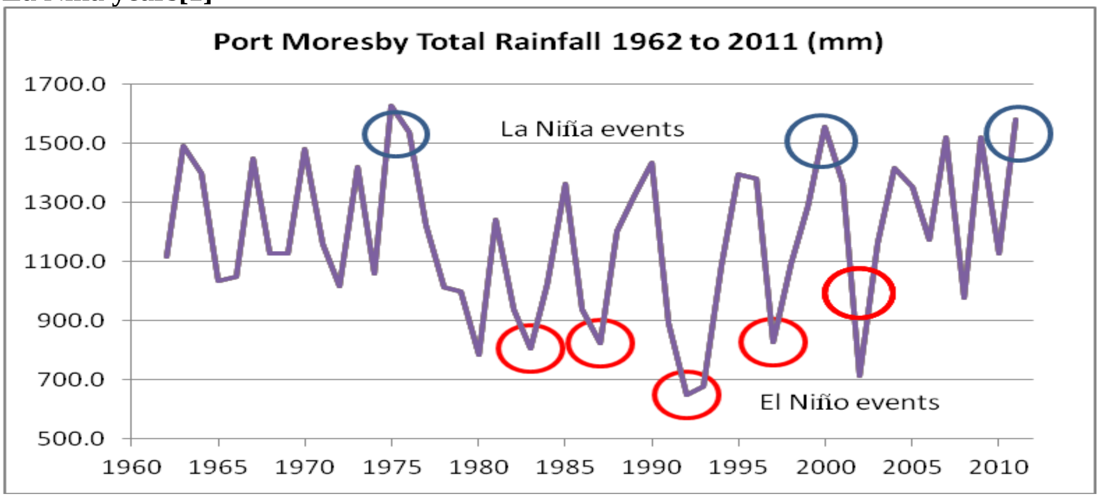
Overview of Natural and Climatic Risk Exposures to Agriculture in Papua New Guinea

Influence of the ENSO Cycle on Rainfall Patterns in PNG

2.25. ***Rainfall patterns in PNG are strongly influenced by the El Niño Southern Oscillation, ENSO, Cycle with droughts in El Niño years and excess rain/flooding in La Niña Years***. The ENSO is a large-scale oceanographic phenomenon which develops in the Pacific Ocean approximately every 3 to 7 years and which is comprised of two cycles, El Niño which is associated with above average sea surface temperatures (SSTs) and reduced atmospheric pressure in the Eastern Pacific bordering South America during the months around Christmas which may extend for several months or up to a year or more, followed by La Niña during which average SSTs in the eastern Pacific are much cooler than average and above average atmospheric pressure applies. An El Niño is typically associated with excess rainfall and major flooding in the Pacific coastal regions of South America (Columbia, Ecuador and Peru) and drought conditions in the West Pacific nations including Australia, PNG, Indonesia and the Philippines. Conversely La Niña is associated with above average tropical cyclone activity and excess rain and flooding in the Western Pacific including in PNG.

2.26. ***Over the past fifty years there have been a number of strong El Niño events including 1965/66, 1972/73, 1982/83, and 1997/98 which was the strongest El Niño on record, followed by moderate El Niños in 1968/69, 1986/87, 1991/92, 2002/0, 2005/06 and finally 2009/10***. Reference to Figure 2.7 and Figure 2.8 shows that during these major El Niño years total annual rainfall at Port Moresby has often been highly reduced and this also applies to Momote station to a lesser extent. During the corresponding period there have been several strong La Niña years including 1973/74, 1975/76, 1988/89, 1999/2000 and most recently 2009/10 when annual rainfall has tended to be well above average at Port Moresby (Figure 2.7), but there is no noticeable La Niña impact at Momote weather station (Figure 2.8). This analysis of ENSO impacts on rainfall in PNG is analysed further in Annex 4. which shows the relationship between average sea surface temperatures (SST) and rainfall. In this case quite strong correlations are observed for Port Moresby between January to May rainfall and January to May average SSTs (R2 – 0.46) and total annual rainfall and annual SST's (r2 -0.55), but in the case of Momote the relationship between rainfall and SSTs is very weak. A severe ENSO event can be expected in PNG roughly every 30 years (Bourke and Harwood, 2009).

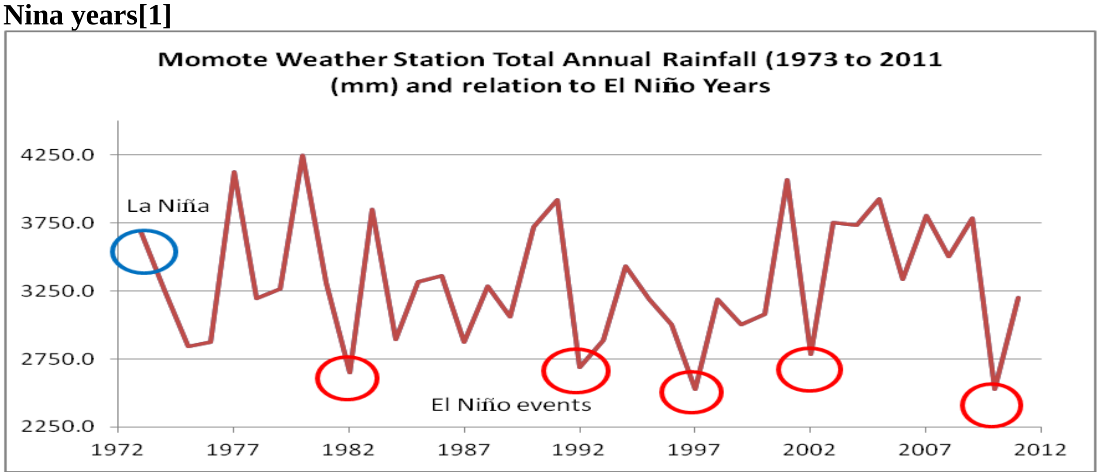
Figure 2.7. Port Moresby: Relationship between Annual Rainfall and Strong El Niño and La Niña years[1]



Source: Authors.

[1] Note: El Niño Years circled in red: La Niña Years circled in blue

Figure 2.8. Momote: Relationship between Annual Rainfall and Strong El Nino and La Nina years[1]



Source: Authors.

[1] Note: El Niño Years circled in red: La Niña Years circled in blue

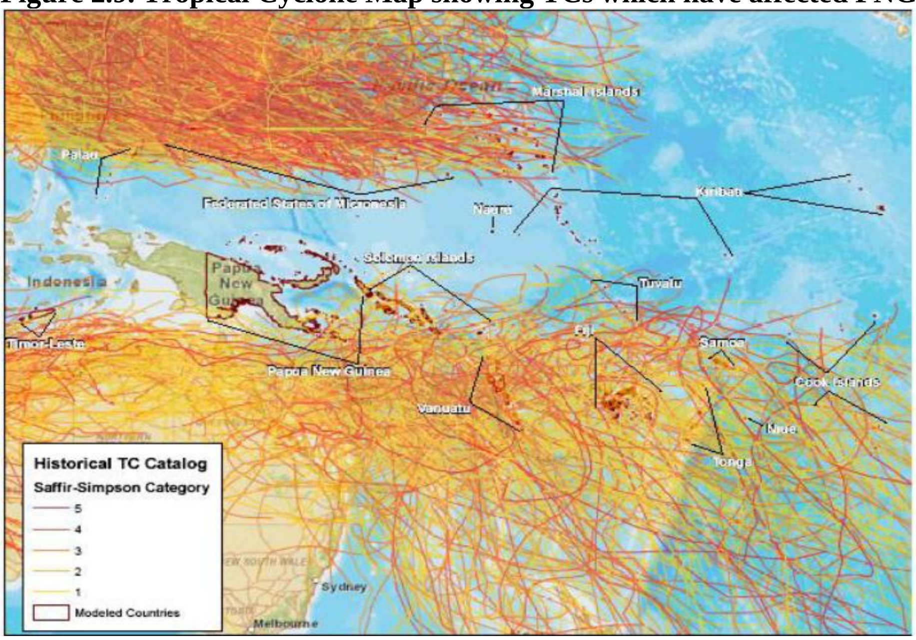
2.27. ***The 1997/98 El Niño related droughts in PNG caused major damage to food crop production in 1997*** and required a major food aid response from GoPNG, Australia and other donor countries (Discussed further in this Chapter).

Tropical Cyclone Exposure

2.28. ***PNG lies directly south of the equator on the north western edge of the South Pacific Ocean Tropical Cyclone (SPAC) belt*** which lies between 130˚E-150˚W and 30˚S-0˚. Most tropical cyclones develop to the east of PNG and track south east thereby missing the country. However, a small number of TC's develop either in the South Pacific Ocean east of Bougainville and or in the Solomon Sea and track South west affecting the south eastern parts of PNG (Milne Bay Province, Central and Northern Provinces). In addition, some TCs develop south of PNG in the Coral Sea and occasionally track due west affecting the southern coastal provinces including Port Moresby, Gulf and Western Provinces.(Figure 2.9).

2.29. To the north of the Equator, PNG is not influenced by the north-west Pacific TC belt (130˚E-180˚, 0˚-15˚N). To the west of PNG, TC's develop in the Southern India Ocean and track due west towards Madagascar and the west coast of Africa. PNG is not affected by Southern Indian Ocean TCs.

Figure 2.9. Tropical Cyclone Map showing TCs which have affected PNG



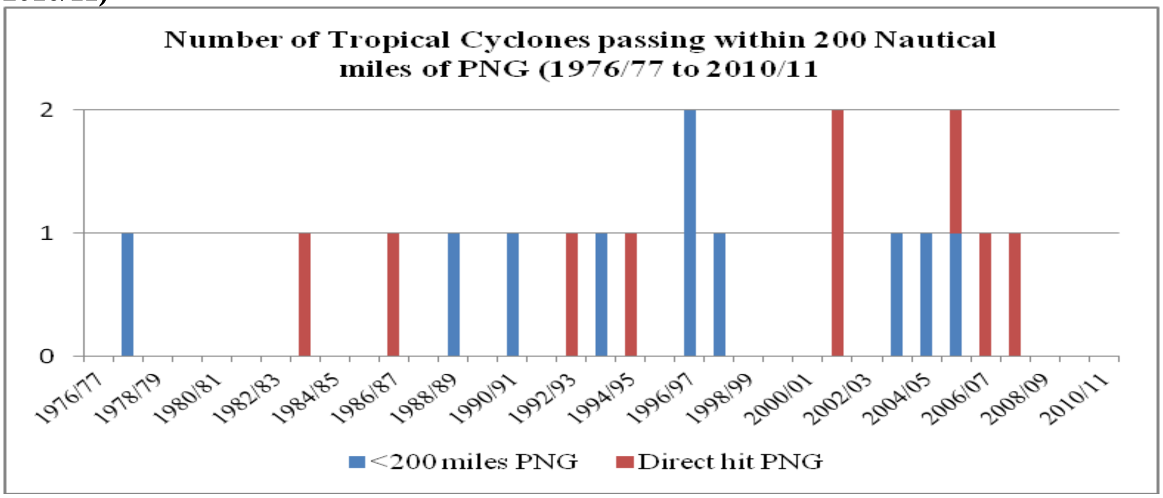
Source: PCRAFI (2011)

2.30. ***An average of nearly 12 Tropical cyclones are experienced each year in the SPAC region, but PNG lies to the north west of this TC belt and the country experiences an average of only 0.54 TC's every year*** (approximately 1 TC every two years). In the SPAC region the hurricane season officially falls between 1st November and 30 April, although some TC's fall outside this season.

2.31. ***Over the past 35 years a total of 19 TCs have affected PNG (for the purposes of this report, defined as those TC's which have tracked within 200 miles of any part of PNG including the 700 or so Islands which make up the country)***. Nine TCs (50% of total) have directly hit some part of PNG, while the other 50% of the TCs have been within 200 miles of PNG (Figure 2.10.). A full listing of the 19 TCs that have affected PNG over this period is attached in Annex 5 along with their individual tracks.

2.32. ***The TC exposure is mainly confined to the south eastern provinces of PNG including Milne Bay, Oro (Northern Province), Central Province and Port Moresby***, although some TCs originating in the Coral Sea or Gulf of Papua have also affected the coastal regions of Gulf and Western Provinces. Also some TCs that develop east of PNG in the Pacific Ocean have affected Bougainville Island in the past 35 years.

Figure 2.10. Number of Tropical Cyclones passing within 200 miles of PNG (1976 to 2010/11)



Source: Author's analysis of South Pacific Tropical Cyclones

2.33. ***Under the Pacific Catastrophe Risk Assessment and Financing Initiative, PCRAFI, simulation modeling was used to develop wind speed probability maps for PNG*** and the other 8 studied South Pacific Island countries. The map in Figure 2.11. shows the levels of wind speeds due to tropical cyclones that have about a 40% chance of being exceeded at least once in the next 50 years (100-year mean return period) for PNG. The map clearly shows the exposure of the south eastern provinces of PNG (Milne Bay, Northern and Central Provinces and Port Moresby and the southern tip of Western Province) and also to wind speeds between 75 mph (threshold for Cat 1 Hurricane) and about 100 miles per hour (Cat. 2 Hurricane). These wind speeds if they were to occur would be capable of generating moderate to severe damage to buildings, infrastructure and crops with consequent significant economic losses. (World Bank 2011).

Figure 2.11. PNG. Wind speed map for PNG.

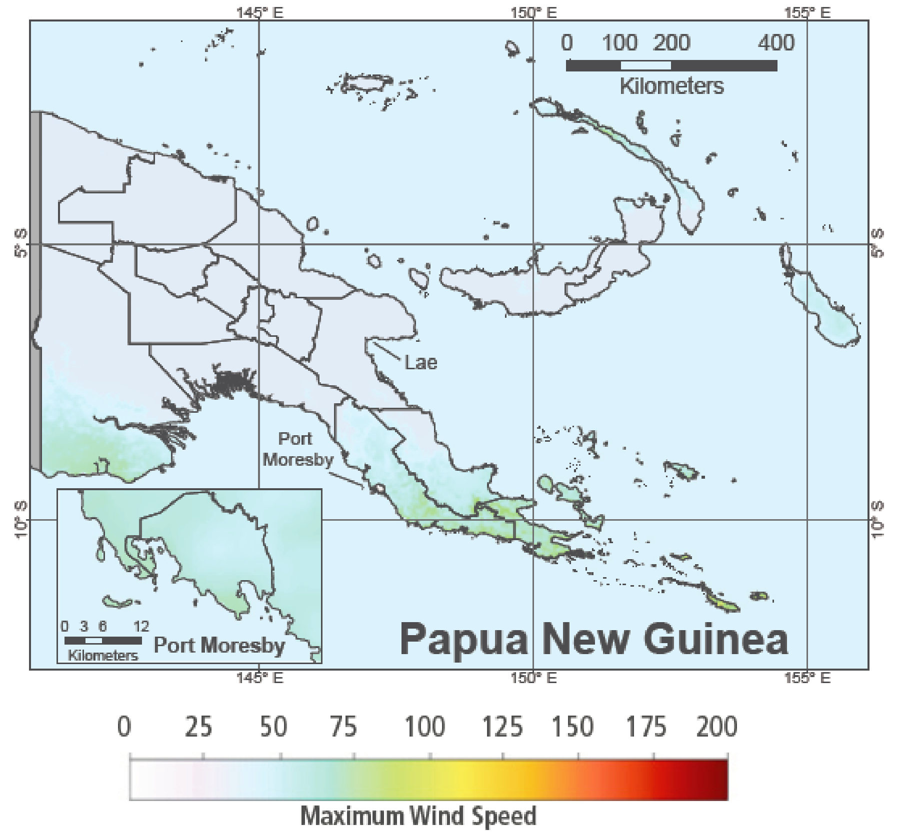


Figure 5: Maximum 1-minute sustained wind speed (in miles per hour) with a 40% chance to be exceeded at least once in the next 50 years (100-year mean return period).

Source: PCRAFI (2011)

2.34. ***Several of the TCs have that have affected PNG over the past 35 years have caused significant damage to property infrastructure (roads and bridges) and agriculture*** including **Adel 1993, Justin 1997 and most recently, Guba 2007**. (Discussed further below). The damage caused by TCs includes physical windstorm damage plus associated damage from torrential rainfall causing widespread flooding and landslides and in coastal areas, further damage is often caused by storm surge.

Other Climatic and Natural Perils Affecting Agriculture in PNG

2.35. ***Flood***. ***In PNG extreme El Nino events are often associated with periods of very high rainfall at the beginning and end of the ENSO event*** and excessively wet periods can seriously disrupt food supply (Bourke and Harwood 2009). In PNG there are several very large rivers which are susceptible to flooding including the Sepik River (East Sepik Province), Ramu River (Madang Province), Markham River (Morobe Province) and localized flooding is also a feature of some parts of the Highlands Region. Excess rain and flooding is also a feature of Tropical Cyclones. Over the period 1992 to 2012, a total of 14 major flood events have been recorded by the Dartmouth Flood Observatory in PNG including 12 heavy rain events leading to flooding and two TC events including TC Guba 2007 (Annex 7). TC Guba caused extensive flooding of the Kumusi and Mambare Rivers and smaller rivers in Oro Province leading to extensive destruction of roads and bridges and causing major business interruption to the deliveries of oil palm fruit to the oil mill located at Popondetta: an area of 12,652 square kilometers in Oro and Milne Bay Provinces was affected by Guba, a total of 170 people died and total damage was estimated at US$ 183 million.

2.36. ***Frost***. Although most of PNG experiences a tropical climate, in the Highlands, frosts can occur at altitudes greater than 2,200 metres. During the 1997 El Nino, the lack of cloud cover for much of the year led to very severe radiation cooling at night in the Highland Region and multiple frost events which caused very severe damage to subsistence food crops and especially to the sweet potato crop. Other severe multiple frost years include 1972 and 1982 (Bourke M., 2001; Bourke and Harwood 2009).

2.37. ***Fire***. Under the slash and burn system used by farmers to clear land in PNG there is always a risk that fire will spread both to the surrounding forest and to cultivated areas with food and permanent crops. Lightning is another cause of fire outbreaks. The 1997 El Nino drought during which many parts of PNG experienced little or no rainfall between April and November 2007 was accompanied by very severe fires particularly in the Highlands of PNG. Fire damage was experienced both to forestry and to food and cash crops. During the period 1972 to 2002, forest fires accounted for about 4.4% of all destroyed or degraded rainforests in PNG equivalent to a fire damaged area of nearly 350,000 hectares (Shearman et al 2008).

2.38. ***Earthquake***. PNG lies on the southern edge of the Pacific Rim of Fire and is a very active earthquake zone. Earthquakes per se are seldom very damaging to agricultural crop and livestock production, but consequential losses caused by landslides and tsunami related flooding may be very damaging to agriculture. (See below for further discussion).

2.39. ***Volcano***. ***PNG is also a very active volcanic zone and active volcanoes include Manam, Karkar, Lamington, Langila, Uluwan, Rabaul and Bagana*** (Annex 6.). There are a particularly large number of volcanoes in West and East New Britain Provinces which are very important oil palm, cocoa and coconut producing regions and also in Bougainville where cocoa is the most important cash crop. Volcanoes have the potential to cause considerable damage to agricultural crop and livestock[12] production through ash fallout and lava flows. Over the period 1901 to 2000 a total of 10 volcanic eruptions were reported. The eruption of Mr Rabaul in 1994 was the most costly single event in PNG in the 20th century with total losses to property and infrastructure estimated at between US$ 110 million (EMDAT) and US$ 530 million (Willis 2008) and which also caused damage to the local cocoa and coconut industries located in the vicinity of the volcano.

2.40. ***Tsunami***. Over the period 1901 to 200 a total of 2 tsunami related wave surges were reported for PNG, and the 1998 event resulted in a very high loss or 2,182 persons[13]. The coastal areas of PNG are low lying and have a high population density: nearly 500,000 people in 2000 coastal villages are vulnerable to flooding by tsunami and tidal surge (World Bank, GFDRR, SOPAC 2010).

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[12] In Argentina in 2011 the volcanic eruption of Mount Puyehue caused more than 0.5 million sheep deaths in Patagonia due to a combination of the weight of ash clogging the sheep's wool which meant the animals could not stand up and starvation due to the grass being buried under many centimetres of mineral ash.

[13] Source: *www.adrc.asia/publications/databook/ORG/databook.../PNG.pdf*

Crop pests and Diseases

2.41. ***Crop pests and diseases are a major problem for annual crops and permanent tree crops in PNG***. In the case of cocoa, the main pest, cocoa pod borer (*Conopomorpha cramerella)* can result in up to 90% loss of the crop if not treated through an integrated pest management IPM approach. Other damaging problems in cocoa include *Pantorhytes* weevils, black pod disease and bark canker disease. In coffee, coffee green scale can cause between 10% and 50% losses in coffee yields and research is currently being conducted into introducing specific parasitoids to feed on the scale insects. PNG is currently free of coffee berry borer which is highly damaging to the crops: this pest is, however, present across the border in Irianjaya, Indonesia and the National Agricultural Quarantine and Inspection Service is active in preventing coffee plantings close to the border to prevent entry of this pest. The major concerns for the oil palm industry are i) basal stem rot caused by the fungus *Ganoderma boninense* and ii) leaf miners, - tettigonids – collectively known as Sexava, which can cause major defoliation of the oil palm trees and loss of yields for the next 2 or 3 years. According to researchers at the OPRA, Hoskins, Sexava attack is closely related to major droughts and after the 1997/98 El Nino, an area of about 850 ha suffered major Sexava damage with lost palm crude oil production valued at US$ 14 million. OPRA is conducting successful research into IPM procedures for controlling Sexava.

2.42. ***Most Crop Insurers will not insure against pests and diseases of crops***. It is important to note that most crop insurance policies specifically exclude cover for pests and diseases as these are deemed to be controllable or influenced by the farmer's management practices (e.g. preventative or controlled spraying of fungicides and pesticides). Were an insurer to offer pest and disease cover this may promote moral hazard by the insured. There are a few exceptions namely on multiple peril crop insurance yield policies, which usually insure against unavoidable and uncontrollable pest and disease losses.

Climate Change

2.43. ***This section review the evidence for climate change in PNG since 1950 and the projections for the remainder of the 21st century and possible impacts on agriculture.*** This Section draws extensively on a recent Australian Bureau of Meteorology and CSIRO (2011) scientific assessment of climate change in the Pacific which also contains a specific country report for PNG, and several recent World Bank/GFDRR/SOPAC publications dealing with climate risk assessment in the Pacific and PNG and adaptation to climate change. The climate projections are based on the results from 18 global climate models, for three emissions scenarios, (B1 low), A1B (medium) and A2 (high) for three time periods, 2030, 2055 and 2090.

2.44. ***Over the period 1950-2009, there are no significant changes in annual and seasonal rainfall in PNG.*** Average annual rainfall is predicted to increase in PNG, by possibly as much as 15% by 2090. In addition the intensity and frequency of days of extreme rainfall are projected to increase over this period, which is likely to bring with it an increase in flood exposure. The incidence of mild droughts is projected to decrease over the 21^{st} century in PNG, while the frequency of moderate to severe droughts will remain stable at one to two events every 20 years.

2.45. ***Since 1950, average air temperatures in PNG have increased by about 0.11˚C per decade.*** These temperature increases are consistent with the global pattern of warming. Climate projections suggest that average temperatures will continue to rise gradually (<1˚C) by 2030, but that by 2090 under the high emission scenario average temperatures may rise by more than 2.5˚C. A similar rate of warming is also predicted for sea surface temperatures. There is some evidence that increases in temperatures may already have permitted coconuts in PNG to be cultivated at higher altitudes in the highland fringes. Increased temperatures will also mean that farmers in the highlands can plant sweet potato at higher altitude because of a decline in frost exposure, but that the Irish potatoes will no longer be able to be grown at the lower altitudes because of heat intolerance (Bourke and Harwood 2009).

2.46. ***In the Papua New Guinea Region projections show a decrease in the frequency of tropical cyclones*** by the last 21st century, but an increase in the proportion of more intense storms which is likely to lead to increased damage.

2.47. ***The sea level has risen around PNG's coastline by an average of about 7 mm per annum since 1993*** and which is significantly higher than the global average of 2.8 -3.6 mm per year. In addition acidification (cased by increasing levels of carbon dioxide) of the ocean surrounding PNG has been increasing since the 18th century. Sea level rises are predicted to increase by between 5-15 cm by 2030 and by as much as 20-60cm by 2090 under the higher emissions scenarios. Sea level rise is already leading to sea encroachment into agricultural lands in low lying areas and salinization of soils and death of crops. For example in the Hoskins area, West New Britain, oil palm plantations bordering the sea which were planted between 15 and 20 years ago are now flooded by the sea for several hundred metres at high tide and the trees have died.

2.48. ***Climate change will have important implications for the design and rating of any crop insurance programs for PNG,*** not least because of the increased variability in extremes of daily temperatures and daily and seasonal rainfall patterns**.**

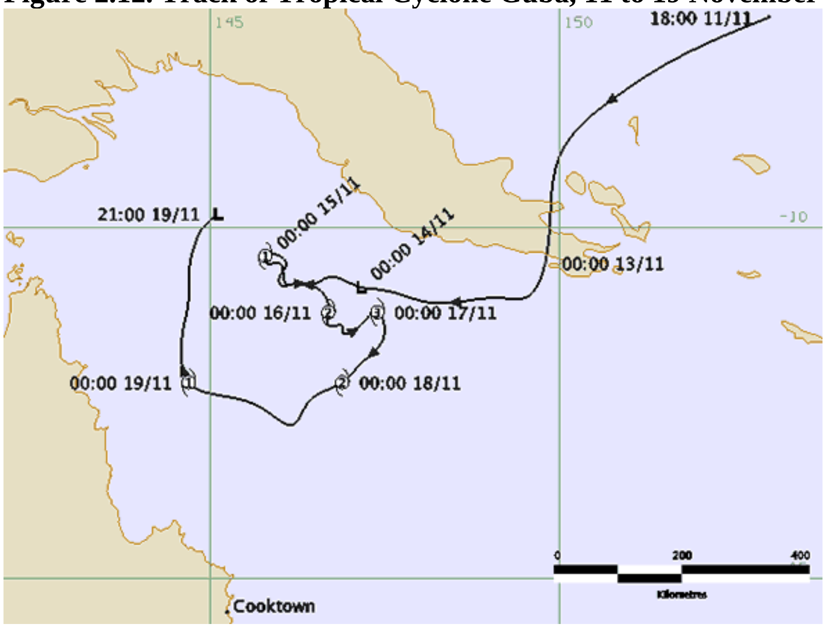
Tropical Cyclone Damage in Plantation Crops – Hurricane Guba

2.49. ***Over the past thirty five years, PNG has incurred moderate to severe damage under three TCs including TC Agnes 1973, TC Justin and most recently TC Guba (November 2007).*** This section briefly considers the damage caused to agriculture by these events and especially TC Guba.

2.50. ***Tropical Cyclone Guba originated north east of New Guinea on 11 November and tracked south west striking Oro Province*** at Popondetta on 12 November when it was associated with Tropical Storm wind speeds and accompanied by five days of torrential rain (12 to 16 November which caused major flooding in Oro Province and part of Milne Bay province a loss of at least 200 lives and displacement of 145,000 people (Figure 2.12). Guba cause major destruction of local infrastructure in Oro Province, with more than 22 bridges destroyed and roads washed away including the strategic bridge spanning the River Kumasi and linking oil palm producing areas to the palm oil mill at Popondetta. The costs of rebuilding the damage were estimated at least K 200 million. The subsequent rehabilitation works are not yet completed and in 2012 there are still some oil palm plantations which do not have road access to deliver oil palm fruit to Popondetta.

2.51. ***Tropical Storm Guba caused a combination of direct physical damage to the oil palm industry in Popondetta in the form of uprooted and washed away trees and then consequential or business interruption losses due to the inability of producers to deliver oil palm fruit to the palm oil factory at Popondetta***. At the time of Guba, the oil palm industry in Popondetta consisted of a Commonwealth Development Corporation Nucleus Estate of about 10,000 Ha oil palm and an additional 15,000 Ha of smallholder (NES) model oil palm production on plots of between two and six hectares of oil palm. It has not been possible to access oil palm industry damage statistics for Guba, but one insurance specialist advised[14] that the nuclear estate may have incurred losses in excess of US$ 30 million and that this was one of the reasons behind CDC's subsequent decision to sell its oil palm interests. The costs of Guba to the smallholder oil palm producers is not known but may also run to tens of millions of US dollars.

Figure 2.12. Track of Tropical Cyclone Guba, 11 to 19 November 2007



Source: Australian Government Bureau of Meteorology

Drought Risk to Food Crop Security in PNG

2.52. ***Over the past 120 years PNG has experienced droughts in 1997, 1987, 1982, 1972, 1965, 1942, 1941, 1931, 1914, and possibly in 1905, 1902 and 1896.*** The very severe droughts of 1914 and 1997 have resulted in major food shortages in much of the country. This section analyses further the rainfall patterns in 1997/98 and the impacts on food production in PNG.

2.53. ***The 1997/98 El Nino droughts were the most severe in a century and affected most of PNG mainland and the outlying Islands***. The drought started in April and lasted in many areas until December leading to a widespread failure of subsistence food crop production. By December 1997 it was estimated that 12 million people in rural areas, or 40% of the rural population of 3.15 million people were suffering severe food shortages and in some cases life threatening shortages (Bourke 2001, Allen and Bourke 2001).

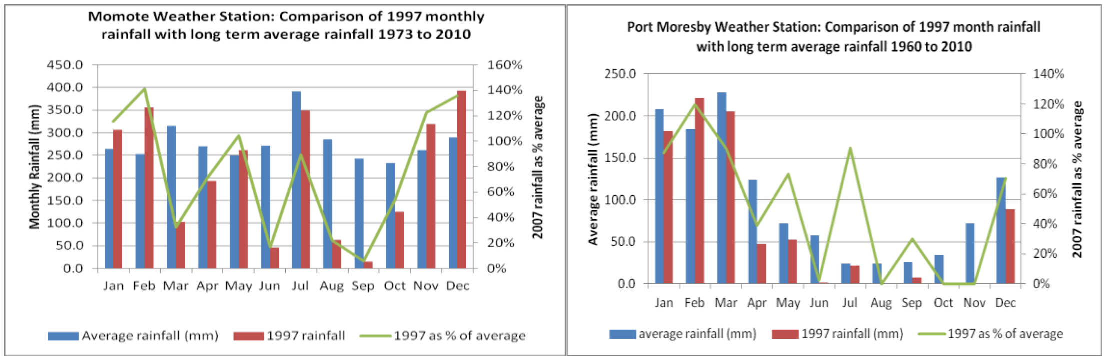
2.54. ***Actual monthly rainfall patterns for 1997 are compared with the long term monthly average for Port Moresby and Momote weather stations.*** The drought was much more severe in the central and southern regions of PNG. At Port Moresby actual cumulative rainfall from April to November was only 30% of the normal average: rainfall was below average in April and May 1997, there was no rain in June, followed by near normal rainfall in July and then practically no rain at all between August and November. A similar pattern was experienced throughout much of

[14] Personal communication with Author during the Pre-Feasibility Study.

PNG. Average annual rainfall at Momote is over 3,000 mm per year and in this case, severe drought was recorded in March, June and August to September 2007 (Figure 2.13).

2.55. ***The acute drought in 2007 led to a major failure of the sweet potato crop in the highlands of PNG and similar losses in many other food crops.*** Other factors which caused the failure of the sweet potato crop include multiple frosts which occurred because of the lack of the normal cloud cover. Bush fires also caused crop losses

Figure 2.13. Comparison of 2007 Actual Monthly rainfall with long-term average, selected weather stations



Source: Author's analysis of PNG National Weather Service data 2012

2.56. ***By July/August 2007 it was apparent that very large numbers of rural communities were suffering moderate to acute food shortages and that the scale or the problem affected as many as 1.2 million persons or*** 40% of the rural population Allen and Bourke 2001). The scale of the food shortages affected much of PNG such that by December 2007 between 20% and 100% of the population in 10 Provinces of PNG were severely or critically affected by food shortages. (Table 2.2). Other impacts of the drought were a severe shortage of drinking water in urban and rural areas and reduced hydroelectric power generation and airport closure due to the smoke from bush fires.

Table 2.2. Summary of Population affected by 1997 droughts and frosts in the worst-hit provinces

Province	**Percentage of Population in drought affected categories 4 and 5[1]**	
	October 1997	**December 1997**
Western	50%	74%
Gulf	11%	58%
Central	24%	50%
Milne Bay	29%	60%
Western Highlands	9%	21%
Simbu	0%	100%
Eastern Highlands	10%	74%
Morobe	12%	55%
Madang	3%	42%
New Ireland	0%	19%

Source: Allen & Bourque 1997, quoted by Humphrey et al 2001

Notes: [1] 4 = severely affected by lack of food supply; 5 = critically affected

2.57. ***In response to the very severe food shortages which in some cases was life threatening, the GoPNG declared an emergency and requested international assistance to provide food aid to rural communities in the affected areas.*** The Australian Government mounted a major program of food aid starting in August 1997. Australia provided some A$30 million relief assistance to PNG for the drought-relief operation. This aid included basic food rations for up to 6 months which was flown by aircraft and helicopter to assist approximately 100,000 people in areas inaccessible by land; new planting material such as seed potato to enable farmers to start replanting their food gardens and medicines. (Sudrajat, 2001). The food shortages lasted until April to June 2008 according to the zone and recovery was delayed due to failure of some of the replanted sweet potato crop to provide normal yields. The overall costs of the drought to the economy of PNG were estimated at up to Kina 500 million (US$ 300 million) in lost foreign exchange reserves (Treasury Minister statement to Parliament, March 4th 2008).

2.58. ***In conclusion, it appears that there is a very close correlation between droughts in PNG and the El Nino phenomenon and that over the last 120 years there have been about 13 El Nino drought events with a return period of about 1 in every 12 years***. Two of these El Nino's were associated with very severe droughts and acute food shortages, 1914 and again in 1997/98. In the other El Nino drought years, however, it appears the negative impact on food security was much lower. (Allen 2001; Bourke and Allen 2001).

Estimated Value of Losses due to Natural and Climatic Perils

Reported per event Damage Data

2.59. ***In many countries the National Disaster Management Agency is responsible for recording the damages arising out of each natural disaster.***

2.60. ***There is, however, very little published information in PNG on the damage associated with major natural and climatic disasters, or on the value of the direct and consequential losses and this applies specifically to the agricultural sector***. Some limited information is summarized in Table 2.3 based on 50 reported loss events occurring between 19901 and 2000 and the original listing by event is presented in Annex 7. It is noted this listing has not been updated to include TC Guba 2007. Additional information updated to 2012 as reported by EMDAT is also presented in Annex 7.

2.61. ***The 1997/98 El Nino drought remains the largest event every reported in PNG with 1***.25 million people affected. The largest number of reported events are earthquakes with 18 events over the 91 year period: earthquakes have also caused the highest number of deaths in PNG. The information presented on the economic costs (value of damages) of natural disasters in PNG is not systematically reported. The largest event is the Ramabaul 1994 volcano with total damage estimated at US$ 400 million. Flood is the major climatic peril reported in PNG with 6 events. This list, however, is very incomplete compared to the Dartmouth Flood Observatory data reviewed in this report and listed in Annex 8.

2.62. ***The major drawback of the available natural disaster data for PNG is that damage to the agricultural sector is not reported***. This implies a need under any future agricultural insurance program to meet with the representatives of each commodity sector in order to try to construct an historical list of all major losses affecting that sector.

Table 2.3. Summary of Natural Disasters in Papua New Guinea (1901-2000)

Disaster Type	No. of Events	No. of Deaths	No. of People Injured	No. of Homeless People	No. of Affected People	Total No. Affected People	Value of Damages (US$ 000)
Drought	3	98			1,246,000	1,246,000	
Earthquake	18	3,523	200	19,000	23,000	42,200	38,375
Epidemic	1	114					
Flood	6	58		78,000	106,000	184,000	14,400
Landslide	6	427	8	5,000	600	5,608	
Volcano	10	3,515	31	46,000	145,500	191,531	400,000
Wave/surge	2	2,193	668		9,199	9,867	
Wild fire	1	0			8,000	8,000	
Wind storm	3	47	40	22,500	25,000	47,540	1,500
Total	**50**	**9,975**	**947**	**170,500**	**1,563,299**	**1,734,746**	**454,275**

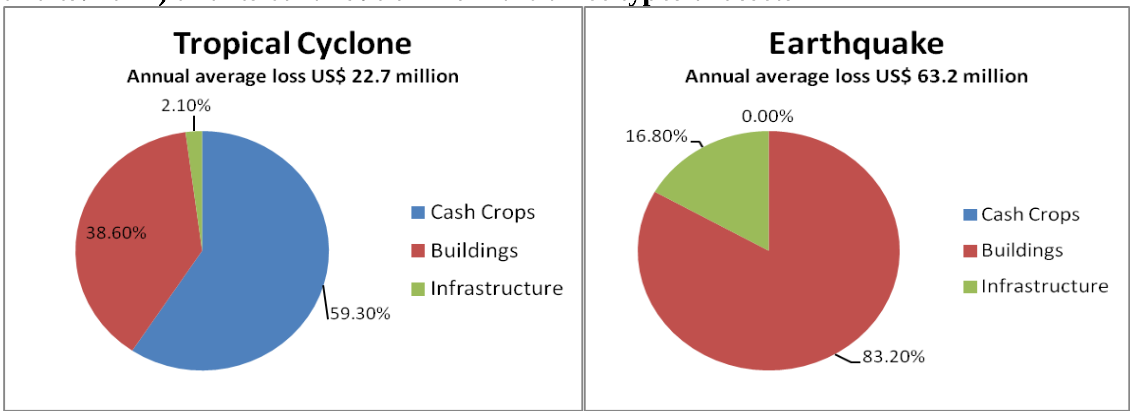
Source: *www.adrc.asia/publications/databook/ORG/databook.../PNG.pdf*

Earthquake and Tropical Cyclone Simulated Damage for Agriculture in PNG

2.63. ***The PCRAFI 2011 study for PNG represents the most comprehensive study to date on the average annual value of losses due to Tropical Cyclone, Earthquake and Tsunami associated with earthquake, for 3 major asset classes, buildings, agriculture and agriculture (cash crops).*** This study involved an exhaustive effort to collect and process data from multiple sources regarding historical earthquakes and tropical cyclones and the monetary losses associated with these events in PNG and then the development of catastrophe hazard and risk models for PNG to estimate both the values of expected annual average losses and extreme of possible maximum loss events (World Bank 2011). When the PNG data-base is made available this will be extremely useful for analyzing further the agricultural risk exposures in PNG.

2.64. ***The results of the PCRAFI 2011 damage modeling shows that Tropical cyclones cause the most damage to cash crops***, with annual average expected losses of 59.3% of total annual losses or US$13.5 million per annum, but in contrast losses due to earthquake in cash crops are negligible (Figure 2.14.). The analysis did not include an assessment of the losses to crops due to tsunami associated with earthquakes but given the fact that much of the oil palm industry in New Britain is located in low lying coastal regions, the impact of tsunami on this sector could be very high.

Figure 2.14. Average annual loss due to tropical cyclones and earthquakes (ground shaking and tsunami) and its contribution from the three types of assets



Source: PCRAFI (2011)

2.65. ***The PCRAFI study also generated estimates of the catastrophic losses that could be expected to be exceeded every 50, 100 and 150 years for earthquake and tropical cyclone***. The analysis shows that expected losses are more frequent and severe for earthquake than for tropical cyclone and that the 1 in 100 year return period expected losses for earthquake are valued at US$ 645 million (7% of GDP) compared to US$ 432 million (5% of GDP) for Tropical Cyclone (Table 2.4.). While the expected losses for the agricultural sector are not shown in this analysis, in the next step of any detailed feasibility study for agricultural insurance in PNG, this data should be accessible from SOPAC (Applied Geoscience and Technology Division, Secretariat of the Pacific Community).

Table 2.4. Estimated Losses for Return periods 50 to 100 years

Mean Return Period (Years)	Average Annual Loss AAL	50 Years	100 Years	150 Years
Tropical Cyclones				
Direct Losses (Million USD)	22.7	218.8	432	776.6
% of GDP	0.20%	2.30%	4.60%	8.20%
Earthquake & Tsunami				
Direct Losses (Million USD)	62.3	460.1	645.5	851.9
% of GDP	0.70%	4.90%	6.80%	9.00%
Tropical Cyclone, Earthquake, Tsunami				
Direct Losses (Million USD)	85.0	582.9	794.9	1091.0
% of GDP	0.90%	6.10%	8.40%	11.50%

Source: World Bank 2011

Livestock Risk Assessment

Livestock Production Systems and Numbers

2.66. ***There has never been a complete census of livestock in PNG and the DAL does not formally record livestock ownership or numbers by district, province and nationally***. The available information on livestock numbers comes from the following sources; Bourke et al 2009, Quartermain 2010 and FAOStat estimates..

2.67. ***According to the 2000 census, about 400,000 households (47% of total rural households)*** are involved in some form of livestock production. Pigs are the most commonly owned class of animal with about 360,000 small owners and village herd of about 1.8 million pigs (average 5 pigs per HH), followed by poultry with 200,000 small owners of about 1.5 million chicken . There are only 4 medium (100-500 pigs) and large (>500 pigs) commercial pig enterprises in PNG. Conversely there is a very large commercial broiler chicken and egg sector in PNG. Beef cattle production has stagnated in PNG over the past 20 years; the national herd is estimated at about 80,000 head of which 80% is managed by large scale commercial ranches. Other smallholder livestock include sheep and goats and rabbits. (Table 2.5.).

Table 2.5. Estimated livestock numbers and meat production 2005

Livestock	Component	Number of herds	Number of Animals	Offtake (%)	Dressed Carcass weight (Kg)	Production
Pigs	Village	360,000	1,800,000	50%	30	27,000 t
	Commercial	111	32,000		48	2,300 t
Cattle	Large-scale ranch		63,500	15%	200	1,900 t
	Smallholder		16,500	15%	200	500 t
Sheep	Smallholder		15,000	30%	12	54 t
Goats	Smallholder		25,000	30%	12	90 t
Chickens	Commercial broilers					17,000 t (frozen)
	Broilers live sales					7,000 t (carcase)
	Commercial layers		161,000			45 million eggs
	Village	27% of HHs	1,500,000			1,850 t (carcase) 6 million eggs
Rabbits	Village		30,000		1.4	168 t

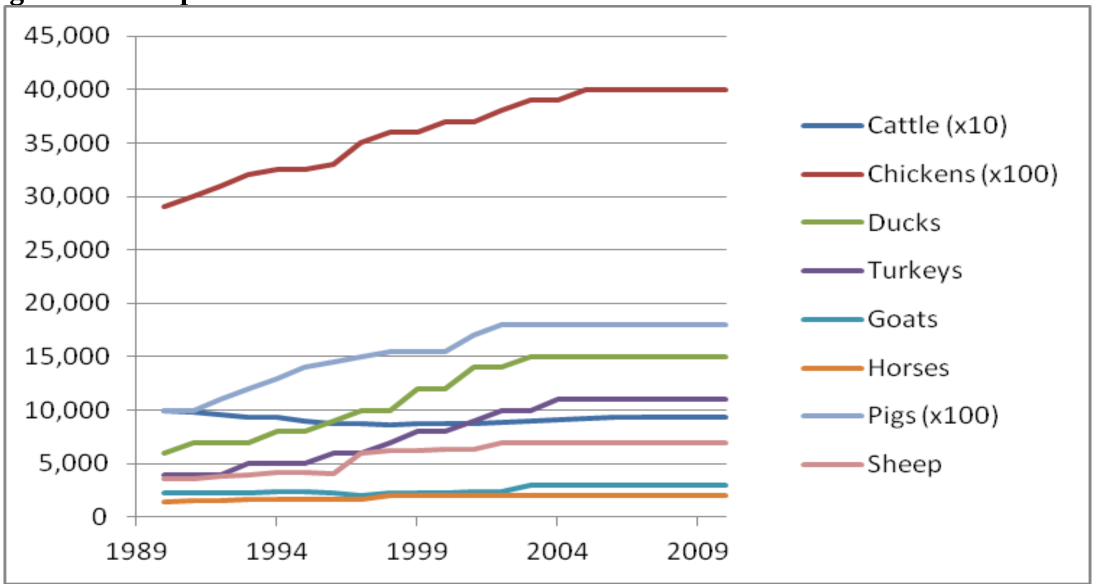
Source: Bourke and Harwood 2009; Quartermain 2010[15]

Note: Most of these livestock estimates are based on Quartermain 2002 and have not changed subsequently

2.68. The available data according to FAO are shown in Figure 2.15 for the period 1990 to 2010. It is noted that the main drawback of this data is that post 2004 estimates have not been updated annually and the estimates have remained the same. According to the FAO figures in 2010, there were 4 million chickens, followed by 1.8 million pigs and 94,000 head of cattle.

[15] Quartermain A.R., 2010. Intensive Livestock Production: Lessons learned and Future Prospects. Papua New Guinea Journal of Agriculture, Forestry and Fisheries, 2010, Vol. 53, Nos 1 & 2, pp51-54.

Figure 2.15. Papua New Guinea: Estimated Livestock Numbers 1980 to 2010



Source: FAOSTAT

Livestock Husbandry and Veterinary Services

2.69. ***The public sector organizations responsible for livestock husbandry and veterinary and vaccination services in PNG*** include: the Department of Livestock, DAL and the National Agriculture Quarantine and Inspection Authority of the DAL. It was not possible to meet the Livestock Department of the DAL during this Mission in order to review the data and information that the department holds on livestock numbers and mortality levels.

Livestock Risk Assessment

2.70. ***In PNG the absence of a national data-base of the numbers of livestock by class of animal*** and by region and by owner and any form of national register of animal mortality levels by cause of loss, means that it has not been possible for the World Bank study team to conduct any formal assessment of the risks facing the livestock industry. Some general comments are made.

2.71. ***Smallholder livestock production of pigs, sheep, goats and chicken in PNG is practiced on a very small scale in family back yards with very low levels of livestock husbandry, management and sanitary standards.*** There is no system for tagging or registering of individual animals or herds with either the DoL or the local veterinary services and few smallholders vaccinate their animals. The low levels of husbandry would not meet the basic management standards which are required by livestock underwriters and furthermore the very small scale of operations would preclude insurance cover because of the very high administrative costs involved.

2.72. ***Conversely there is a growing medium and large-scale commercial poultry and pig production sector mainly located in the Markham Valley and these enterprises adopt relatively high levels of animal husbandry and sanitation***. It is understood that some of the largest pig and poultry producers may currently purchase property fire and allied insurance cover for their livestock enterprises. (See Chapter 3 for further discussion of issues relating to livestock insurance).

Conclusions on Crop and Livestock Risk Assessment

2.73. ***The lack of available time-series crop and livestock production data and also weather data*** severely limits the assessment of risk in PNG as well as restricting the scope for the design and rating of traditional and or parametric crop and livestock insurance products and programs.

2.74. ***The vulnerability of the oil palm industry in Oro and Milne Bay Provinces*** to ***tropical cyclone wind and excess rain/flood damage*** suggests that there may be scope to develop suitable wind storm crop insurance cover especially for the smallholder farmers whose livelihoods are dependent on oil palm production and sales. This cover could either be based on a traditional damage-based indemnity policy or based on a windstorm index policy. This theme is developed further in Chapter 3.

2.75. ***The high ENSO related drought risk exposure to smallholder food crop production*** suggests that there may be a role to develop suitable crop insurance cover to protect against drought in food crops. The very small scale of food-crop production in PNG (subsistence farming and mixed cropping in small garden plots) does not lend itself to insurance under a conventional individual farmer (micro-level) crop insurance program for reasons of the difficulty of designing and rating such coverage and the prohibitive costs of administering an individual policy. However, there may be scope for developing a macro-level food security cover for GoPNG. (See Chapter 3 for further discussion).

2.76. ***Fire is identified as an important risk exposure in tree cash crops such as oil palm, coffee, cocoa and rubber.*** There may be scope to develop named peril fire and allied peril cover for specific crops such as oil palm and rubber**.**

2.77. ***Flood is a major cause of loss in agriculture in PNG,*** and both crops and livestock are vulnerable to flood damage. Flood damage is caused both by direct physical damage and consequential / business interruption losses due to disruption of transport and communications, preventing farmers from selling their crops. Flood is, however, a very complex peril to insure in agriculture and in the short term is unlikely to be developed in PNG.

2.78. ***For livestock there appear to be very limited opportunities for developing cover for small holder farmers***, but it may be possible in future to develop cover for large commercial pig and poultry operations.

Chapter 3: Agricultural Insurance Opportunities and Challenges for Papua New Guinea

3.1. This chapter presents a review of the crop and livestock insurance products that are available internationally and their potential suitability to farmers, financial and other rural aggregators (rural banks, cash crop production and export companies) and to GoPNG.

Role of Agricultural Insurance and Demand and Supply of Agricultural Insurance in Papua New Guinea

The role of agricultural insurance

3.2. ***Farmers face a whole myriad of risks that can threaten their output, their income, and ultimately their consumption.*** These include idiosyncratic risks such as fire, hail, health which affect farmers independently through to systemic risks such as drought or output prices or epidemic diseases of livestock which affect a large number of farmers at the same time. (Table 3.1.). In addition to these risks, farmers face constraints (e.g. lack of access to agricultural credit, inputs or output markets, or to technical and advisory services).

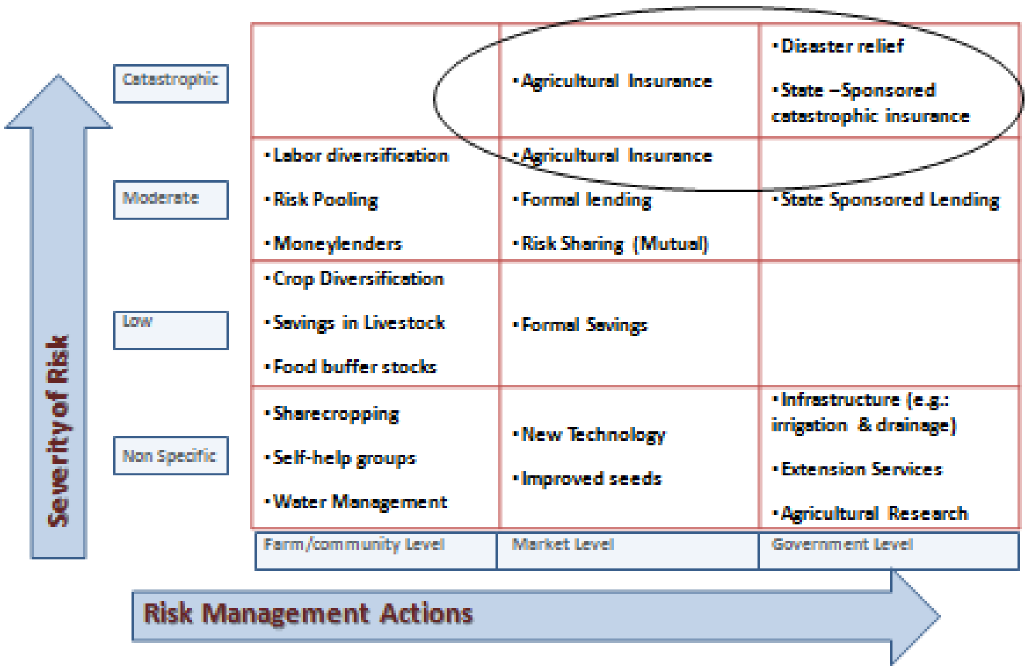
Table 3.1. Key Risks faced by farmers

Risk	**Examples/factors**	**Effects**
Weather risks	Idiosyncratic: hail, Systemic: drought, hurricane, flood	Lower yields, loss of productive assets or income
Biological Risks	Crop pest, disease, contamination, livestock epidemic diseases	Lower yields, death of livestock, loss of income
Natural risks	Fire, earthquake, volcano, tsunami	Lower yields, death of livestock, loss of income
Price Risks	Low prices, market supply and demand, volatility	Lower prices, loss of income
Labour and health risks	Illness, death, injury	Loss of productivity, loss of income, increased costs
Policy and political risks	Regulatory changes, political upheaval, disruption of markets, unrest	Changes in costs, taxes, market access

Source: adapted by author from ARMT, World Bank

3.3. ***Farmers can use various risk management strategies and mechanisms, whenever they are available, to mitigate against or to minimize the adverse impact of these multiple sources of risk in agriculture.*** These risk management mechanisms can be divided into informal (household and community based) mechanisms, and formal market mechanisms where these exist and finally formal government interventions (Figure 3.1.). Agricultural insurance is one of the risk management tools that farmers and livestock producers can us to transfer catastrophe risk that they cannot otherwise manage. In addition, in many countries, governments' intervene in the case of natural disasters to provide disaster relief and or state supported catastrophe agricultural insurance usually under some form of Public Private Partnership. (Figure 3.1.)

Figure 3.1. Mechanisms for Informal and Formal Risk Management in Agriculture



Source: ARMT, World Bank

Farmer Segmentation and the Role of Agricultural Insurance in PNG

3.4. ***In PNG it is possible to distinguish between the following types of farmer*** and production enterprises:

1) **Subsistence Farmers** with small-scale food and livestock production in household gardens, producing solely or primarily for on-farm household consumption. It is understood this category of farmer accounts for the very large majority of PNG's farmers.

2) **Small semi-commercial farmers** producing both food and cash crops (e.g. coffee, cocoa, oil palm, rubber possibly as part of a nucleus estate out-grower program) for sale and who purchase inputs and whose income depends mainly on sales of crop and livestock output. This sector is relatively important in PNG as many smallholders are involved in cash crop production.

3) **Medium to Large scale commercial farmers – cash crops and or livestock (e.g. poultry).** There are very few medium or large scale commercial farmers in PNG

4) **The plantation estates –** Limited companies involved in export cash crop production (oil palm, cocoa, rubber etc) and large scale commercial livestock breeding. The number of these companies is very much reduced today as the bulk of export tree crop production is managed by smallholders in PNG.

3.5. ***Agricultural insurance is best suited to protecting semi-commercial and commercial farmers who adopt improved technology and purchased inputs often on credit and who produce crops or livestock for sale as opposed to for on farm consumption.*** These farmers have a financial investment tied up in the crop or livestock enterprise and crop ensure may enable them to pursue riskier, but potentially much more profitable farming activities which usually centre on the use of credit to purchase new production enhancing technology (IFAD and WFP, 2010). For these farmers, agricultural insurance has the potential to play an important role in leveraging small farmers' access to rural finance. Financial institutions are often willing to use a crop insurance policy as a substitute for traditional collateral requirements and that they are more willing to lend to these farmers because their loan is protected against climatic risk and production shortfall induced default. In PNG there may be scope for developing specific crop insurance products for small and medium commercial farmers producing cash crops such as oil palm and rubber and possibly cocoa.

3.6. ***Traditional and or index-based individual farmer crop insurance cannot provide solutions for subsistence farmers in PNG***. There is much evidence today that traditional individual farmer multiple peril crop insurance (MPCI) does not work for small and marginal farmers and usually ends up being heavily subsidized by governments. For small subsistence farmers producing food crops for on-farm family consumption, crop insurance is a luxury few of them can afford and crop insurance does not meet their food security requirements. For subsistence farmers it may be much more cost-effective for governments to examine alternative food security mechanisms and social safety nets or, where they elect to use insurance, to consider some form of macro-level weather index programme to permit early payments to be made in the event of a major natural disaster. In the case of PNG, this pre-feasibility study concludes that it will not be feasible or appropriate to try to develop individual farmer crop insurance solutions for the small subsistence farmers.

3.7. ***At a national level there appears to be opportunities in PNG to link disaster risk management with an ex-ante macro-level weather index insurance policy specifically designed to insure against ENSO drought and food shortages***.[16] To date, several countries including Ethiopia, Malawi and Mexico have designed macro-level rainfall deficit index covers that have been designed to provide governments with immediate cash liquidity following a natural disaster and to enable the government to provide an early response, and WFP/IFAD are currently designing a pan-African drought pool cover to protect national governments in the event of catastrophe droughts. There may therefore be considerable scope in PNG for using macro index products as a social safety net product for small subsistence farmers for whom commercial crop insurance is not necessarily an appropriate or cost-effective mechanism**.**

3.8. ***Agricultural insurance can also be used as a meso-level instrument to protect rural bank lending (loan portfolio or business interruption protection).*** From the bank's perspective, farmers who have crop insurance protection are less likely to default on their loans in the event of major weather induced crop failure. It also means that in the event of a major regional flood or drought the bank's loan portfolio is protected against loss, enabling the bank to remain solvent and to reschedule farmers' loans and to continue lending. Claiming on a crop insurance policy and rescheduling loans are generally much more acceptable to a bank than having to resort to the courts to recover their debts.

[16]For a comprehensive review of linkages between disaster risk reduction and index insurance see Warner *et al*, 2009.

Demand and Supply of Agricultural Insurance in PNG

3.9. ***To date no commercial insurance company in Papua New Guinea has underwritten any growing crop or livestock insurance policies and in the absence of any agricultural insurance provision, it would appear most farmers have no knowledge or awareness of this class of insurance***. Most PNG farmers have no knowledge or experience of crop and livestock insurance and the potential benefits and constraints of such products. In the absence of a functioning agricultural insurance market, it is difficult to quantify objectively farmer's potential demand for these at present hypothetical insurance products. Some of the large estates purchase post-harvest insurance for crops in transit and or processing and in storage.

3.10. ***During this Pre-Feasibility Study some initial demand assessment work was conducted with the panel groups of coffee farmers in Goroka, Eastern Highlands Province and oil palm farmers at Hoskins, West New Britain[17].*** The purpose of the panel discussions was to elicit information on the main farming practices, constraints to production, the key natural, climatic and biological risks their frequency and severity and knowledge of and potential interest in crop insurance. It is stressed that these discussions were held with small groups of between 5 and 20 farmers and the findings cannot be considered to be statistically representative.

3.11. ***The findings of these group discussions suggest that for many coffee farmers crop insurance is a very low priority compared to finding solutions to their value chain supply constraints.*** Coffee farmers interviewed in Goroka typically had between 0.5 Ha and 3 Ha of coffee and one had 15 Ha. Farmers are exposed to a wide range of production constraints including limited access to working capital with which to purchase inputs (fertilizers and pesticides) high input prices, pests and diseases, poor access roads from field to markets and lack of equipment (e.g. coffee fruit pulper). Coffee farmers mentioned that excess rain at the time of flowering reduced fruit set and that the El Nino 1997/98 drought had caused the coffee bushes to dry and lose their leaves with reduced yields (in fact the November 2007 rains were sufficient to ensure the coffee industry recorded one of its best harvests ever in 1998). Frost in coffee was not identified as a problem, but localized hail was observed about 1 in 5 years in November. Localised windstorm and fire were also identified as problems in coffee plantations which could severely damage the coffee bushes. Coffee farmers' knowledge and understanding of insurance was very low and for the interviewed group their priorities were to overcome the supply chain constraints as opposed to purchasing agricultural insurance.

3.12. ***Oil Palm farmers interviewed at Hoskins West New Britain highlighted their concerns over sea level rises and intrusion of sea water into their oil palm plantations and in this case were interested in the potential to buy an insurance which would cover sea level rise.*** Oil palm farmers highlighted problems of sea water intrusion into their oil palm holdings located close to the sea shore – salt water kills the palms- pest problems (sexava) the lack of power, poor access roads to their holdings, costs of inputs and low output prices. In the 1997/98 El Nino drought several farmers experienced severe fires in their oil palm. Some farmers had experienced localized wind damage to their oil palm trees 5 to 7 years previously, but none could recall a tropical cyclone hitting their plantations over the 20 or more years they had farmed in the Hoskins area. (Reference to Figure 2.11, Chapter 2 shows that West New Britain lies outside the South Pacific TC zone). Oil palm farmers whose lands are close to the sea and has been damaged by salt water were interested in some form of crop insurance protection against this risk. During this pre-feasibility study it was not possible to visit the oil palm areas in Oro Province damaged by

[17] Logistical constraints meant it was not possible to conduct a third field visit to livestock producers in the Markham Valley, Morobe Province.

Tropical Cyclone Guba in 2007 in order to review the damage and to elicit farmers' potential interest in wind storm insurance cover.

3.13. ***On the basis of this study it appears that the large oil palm estates are unlikely to be interested in purchasing Tropical Cyclone cover for their own commercial plantations.***

Types of Agricultural Crop Insurance Products

3.14. ***This section reviews the types of crop insurance product that might be developed for PNG while livestock insurance products are reviewed towards the end of Chapter 3.***

3.15. ***There are two major classes of crop insurance products (a) traditional indemnity-based crop insurance products and (b) the new index-based or parametric crop insurance products.*** Box 3.1 highlights the main features of these indemnity based and index based crop insurance products currently available in international crop insurance markets and Table 3.2 provides a preliminary assessment of each product's potential suitability for development in PNG.

3.16. ***An indemnity-based*** crop insurance product involves the in-field measurement of physical damage or yield loss to an insured crop against a pre-agreed insured amount of physical production: **an index insurance** policy uses a proxy variable such as the amount of rainfall during the growing season to approximate the impact of rainfall deficit on a crop, but it does not involve any form of in-field damage assessment to establish the amount of indemnity.

3.17. ***Damage-based and loss of yield crop insurance has been available internationally for more than 100 years***. Weather index insurance has only been available since the early 2000s. The most recent developments are in the applications of remote sensing/satellite based index products including NDVI-based pasture insurance indexes for livestock producers in several countries including the USA, Canada, Mexico, Spain and Kenya. Also there is a lot of research into satellite-based synthetic rainfall index covers which establish historical rainfall datasets on a gridded-basis and which provide an alternative where the density of ground-based weather stations is inadequate to support rainfall index insurance.

Box 3.1. Crop insurance products: Indemnity-based and index-based covers

Traditional crop insurance:

Damage-based indemnity insurance **(named peril crop insurance) -** In this type of crop insurance 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 crop 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, excessive rainfall, wind).

Yield-based crop insurance **(multi-peril crop insurance, MPCI) -** In this case, an insured yield (e.g. tons/hectare) is established, as a percentage of the historical average yield of the insured farmer. The insured yield is typically between 50 percent and 70 percent 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 the loss.

***Crop revenue insurance* -** This product combines conventional loss crop yield based MPCI insurance with protection against loss of market price at the time of sale of the crop. Currently, this product is only marketed on a commercial basis in the USA for grains and oilseeds that are quoted on commodity markets (Chicago Board of Trade) and where future price contracts can be combined into the revenue policy.

***Greenhouse insurance*.** A specialist type of agricultural insurance cover combining material damage cover to greenhouse structures and equipment and also conventional crop insurance cover (usually restricted to named perils) to the covered greenhouse crop.

Forestry insurance. Traditional damage-based indemnity insurance against fire and allied peril losses in standing timber. The valuation for insurance and indemnity purposes is often based on the investment and maintenance costs up to the point where the trees can be harvested for timber following which the valuation is based on the commercial value of the standing timber.

Index-based crop insurance:

Area-yield index insurance - Area-yield index insurance is insurance where the indemnity is based on the realized (harvested) 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 and typically ranges from 50 percent to a maximum of 90 percent of the area average yield. An indemnity is paid if the realized average 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 on which basis one can establish the normal average yield and insured yield.

Weather index insurance - This 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 (e.g. US$/millimetre of rainfall).

***NDVI/satellite insurance* -** This refers to indexes constructed using time-series satellite gridded rainfall, or remote sensing imagery, for example applications of false colour infrared waveband to pasture index insurance where the payout is based on a NDVI (normalized dry vegetative index), which relates moisture deficit to pasture degradation. Research is currently being conducted into applications of SAR (synthetic aperture radar) to crop flood insurance.

Source: Mahul and Stutley, 2010.

3.18. ***On the basis of this pre-feasibility study, it appears that there may be scope in PNG to design an individual grower traditional named peril damage-based cover to protect the oil palm sector against tropical cyclone damage***. Under certain circumstances it might be possible to obtain underwriters approval to include fire and or volcanic eruption for this cover. Such a program is only likely to work where there is a well established outgrower-network for the oil palm producers and cover might be marketed as a meso-level product through the nucleus estate and or through banks lending to oil palm producers.

3.19. ***Alternatively, it might be feasible to design a Tropical Cyclone Index for the oil palm out-grower farmers.*** The relevant merits of these two products (named peril damage-based versus are reviewed in the next section**.**

3.20. ***A similar named peril damage-based crop insurance cover could be designed for the rubber sector which would protect against fire and possibly wind.*** In the first instance it is recommended that this cover would only be offered to farmers in the Fly River Smallholder rubber scheme in Western Province.

3.21. ***At a macro-level it could be feasible to develop an ENSO-El Nino drought insurance index cover, probably using satellite rainfall to protect against major food crop failure***. Such a cover would be offered to the GoPNG to provide a source of timely contingency funding for the purchase of food assistance for subsistence farmers in drought-affected districts and Provinces.

3.22. ***There is, however, very little immediate scope to develop loss of yield based indemnity products because of the lack of time series crop production and yield data in PNG.*** Two types of loss of yield policy are highlighted in Box 3.1. and Table 3.2, first a traditional individual grower Multiple-peril crop insurance policy (MPCI) which insures individual growers for loss of crop production and yields in their own fields and second an area-yield index insurance (AYII) product which insured farmers in a given area such as a district against an index established as a percentage of the average county yield. The AYII product has been widely adopted in India under the National Agricultural Insurance Scheme (NAIS), a small farmer crop-credit insurance program which currently insured over 25 million Indian farmers. In PNG there are no immediate opportunities for AYII in field crops because of the lack of time-series crop production and yield data. The AYII product is not very suitable for tree crops such as coffee, cocoa and oil palm.

3.23. ***There is also very low potential in the short term to develop rainfall and temperature based weather index insurance covers for individual farmers based on ground***-based weather stations due to the current lack of operational meteorological weather stations in PNG. In the medium term this may change due to the investments being made into new weather stations by the EU-UPGN-Digicel, World Bank and other organizations.

Table 3.2. Suitability of Traditional Indemnity-based and Index based Crop Insurance Products for Papua New Guinea

Type of Crop Insurance Product	**Basis of Insurance & Indemnity**	**Suitable for Papua New Guinea?**
C. Traditional Individual Farmer Indemnity Insurance		
1. Single peril (e.g. Tropical Cyclone, Wind)	% Damage	POSSIBLY outgrower schemes for oil palm and rubber
2. Named Peril (e.g. Fire, Wind, Volcano)	% Damage	POSSIBLY outgrower schemes for oil palm and rubber
3. Multiple Peril Crop Insurance (MPCI)	Loss of Yield	NO
4. Revenue Insurance	Loss of Yield and Price	NO
D. Innovative Crop Index Insurance		
5. Aggregate Yield Shortfall Insurance	Loss of Aggregate Yield	NO
6. Area-Yield Index Insurance (e.g. India, USA)	Area-Yield Index	NO
7. Crop Weather Index Insurance (WII):	Weather Index (e.g. rainfall)	

7.1. Micro-WII (Individual farmers) (e.g. Malawi)	Weather Index (e.g. rainfall)	NO
7.2. Meso-WII (Financial institutions, input suppliers)	Weather Index (e.g. windstorm, hurricane)	POSSIBLY – outgrower schemes for oil palm
7.3. Macro-WII (Government)(e.g. Malawi, Ethiopia)	Weather Index (e.g. rainfall)	POSSIBLY using satellite rainfall – see Product 8.
8. Remote Sensing Indexes (e.g. Satellite Rainfall index; NDVI/drought pasture indexes for livestock, Satellite Imagery or Synthetic Aperture Radar, SAR, for Flood)	Remote Sensing Index (e.g. Satellite Rainfall Index)	POSSIBLY National drought insurance scheme for food security

Source: Author based on survey findings

3.24. ***The sections below present a review of the main features of the traditional and index crop insurance products that may possibly be suitable for further research and development for PNG***:

Opportunities for Named-Peril Windstorm in Plantation Crops (Oil Palm, Rubber, Cocoa)

3.25. ***The findings of this pre- feasibility study suggest that in PNG there may be potential to develop named-peril crop insurance for Windstorm (Tropical Cyclone) damage in tree crops including oil palm and possibly rubber and cocoa.*** It might also be possible to extend cover to include fire and volcanic eruption. Features of the named peril product are reviewed below along with the opportunities and challenges for PNG. Initially this product would only be applicable for large plantation estates, or estates with well defined out-grower networks.

Features of Named-Peril Damage-based Policies

3.26. ***Under a named-peril damage-based indemnity system, physical loss or damage to the insured crop is measured in-field soon after a specific loss event due to an insured peril and the claim is usually settled shortly after the time of loss***. Normally the damage is measured as a percentage loss, and this percentage is applied to the agreed sum insured (i.e. incurred production costs) for the crop. The sum insured may be adjusted downwards if the actual crop is found to be below the normal production potential for uninsured reasons, for example, poor crop establishment. A deductible is usually applied to the loss expressed as a "percentage damage" although this can be a fixed value. This method is most applicable to programs with a single or a limited number of discrete event perils (e.g. hail, fire, wind storm, frost).

3.27. ***The key advantages of a named-peril damage-based indemnity policy include:*** (a) there is no need to collect time-series individual grower production and yield data on which basis to establish a normal average yield and then an Insured Yield because the policy uses a damage based indemnity procedure rather than loss of yield; (b) the sum insured can be set according to an agreed value per hectare, based either on production costs, or production costs plus an element of the expected gross margin profit, or finally a revenue valuation based on the farm-gate sale price of the crop times the expected output and finally (c) loss adjustment is based on percentage damage estimation to the crop according to its growth stage and this procedure is usually easier and cheaper to implement than yield-based loss assessment.

3.28. ***The drawbacks of damage-based crop insurance and indemnity policies include***: (a) the product is best suited to specific event perils that cause obvious and easily measured damage to the crop such as fire, hail or wind and sometimes frost or excess rain, but it is not suitable for progressive perils which impact over time on the crop such as drought and where losses can only be objectively measured in terms of yield reduction or loss and (b) the product is not very suitable for other perils such as flood. Indeed flood is not usually offered by insurers as a single-peril on traditional indemnity-based crop insurance policies because of the problems of anti-selection and the difficulties of accurately assessing the percentage flood damage to crops, especially in tree crops.

International experience with named peril windstorm cover in Oil Palm and Rubber

Oil Palm:

3.29. ***Oil Palm is generally regarded as a very damage resistant crop and the main demand is from the large commercial plantation sector for fire and allied perils cover such as Tropical Cyclone***. Malaysia has a lengthy experience with oil palm insurance in this case for fire plus allied perils including windstorm and sometimes flood and damage by wild animals (rats and elephants can cause major damage in young oil palm seedlings. Other neighbouring countries which insure oil palm include Indonesia (a fire plus allied perils including windstorm is offered by the local market), and China. A copy of the Malaysian Named Peril damage-based Policy wording for oil palm (rubber and cocoa) is attached as Annex 9. The policy is based on a London market standing timber fire plus allied perils policy. The key features of this policy are summarised in Box 3.2.

Box 3.2. Malaysia Named Peril (Fire, Windstorm and Flood) Policy for Oil Palm, Rubber and Cocoa

Policy Type: Insurance of Growing Trees (Damage based insurance and indemnity cover)

Period: 12 months

Insured Trees: Oil Palm, Rubber, Cocoa. Insured trees are those greater 3 years age (5 years for rubber trees) and not older than 25 years (30 years for rubber and cocoa)

Insured Perils: Fire plus allied perils Windstorm and or Flood

Definition of windstorm: winds of sufficient velocity to cause actual physical damage to the insured trees as defined in the policy (snapping, toppling, uprooting).

Sum Insured: Agreed value basis (this could be based on the investment costs and annual maintenance costs up to the time of loss, or a revenue based valuation or an internal rate of return based valuation

Excess: each and every loss basis

Definition of Each and Every Loss: Windstorm 72 hour standard clause; Other perils 24 hours clause.

Claims Procedure: In field damage assessment according to standard procedures for assessing damage caused by each peril to the insured trees. The extent of loss is derived by applying the loss settlement scale to the sum insured for each destroyed or damaged tree.

Source: Author based on Malaysian Insurance of Growing Trees Policy Wording (Annex 9)

Rubber:

3.30. ***China (currently) and Malaysia (historically) are among the few countries operating commercial named-peril wind storm insurance programs for rubber plantations***. Rubber production in China is mainly located in Hainan Island which is very exposed to typhoon damage. The Peoples Insurance Company of China, PICC, Ltd has for a number of years operated a named peril windstorm damage-based indemnity policy for rubber plantations. The policy covers physical loss or damage to the rubber trees including snapping of the main tree-trunk, toppling of the tree and or lodging of the tree. Loss assessment is based on in-field individual tree damage assessment procedures and the loss settlement scales for rubber are rather more detailed than those used in Malaysia (Further details of the PCIC Policy are contained in Annex 10).

Cocoa:

3.31. ***In Malaysia named peril damage-based insurance is available for cocoa against fire and allied perils (including windstorm).*** The cocoa policy is the same as the standard oil palm and rubber policy and the only differences are the indemnity scales that apply to the estimated damage caused by each insured peril (See Annexes 8 and 9).

Opportunities and Challenges for Named Peril Fire and Windstorm Cover for Oil Palm, Rubber and Cocoa Plantations in PNG

3.32. ***Oil Palm is the largest export crop earner for PNG with a total planted area of about 128,000 Ha and fresh bunch production of 2,2 million tonnes with export revenue for palm oil of about K 670 million in 2007.*** Under the private public partnerships with government there are 5 major project areas, Hoskins and Bialla in West Nest Britain Province, Popondetta in Oro Province, Gurney and Sagarai in Milne Bay Province and Kavieng in New Ireland Province (Table 3.3).

3.33. ***All the major oil palm projects are based on a nucleus estate and smallholder (NES) model*** in which a commercially operated estate company produces oil palm and also provides a market, processing and technical services for smallholder producers who cultivate oil palm on blocks of land in the vicinity of the nucleus estate. The NES model was formerly based on a Land Settlement Scheme (LSS) system under which settlers were granted 99 year leases on blocks of about 6 Ha which were purchased from customary owners, but because there have been no new land settlement schemes since the mid 90s, the LSS system has been replaced by the Village Oil Palm System VOP which provides lease agreements on blocks of 2 to 4 Ha of land (Bourke and Harwood 2009).

3.34. ***Under the potential oil palm windstorm tree crop insurance cover, the primary target for insurance would be the smallholder outgrowers located in Popondetta and Milne Bay where there is an exposure to windstorm damage every decade or more.*** On the basis of discussions with the oil palm industry it is understood that the large commercial estates are unlikely to purchase windstorm cover for their own estates. However, it is hoped that these estates will promote windstorm cover, possibly on an automatic basis for their nucleus settlers and especially those who are recipients of production credit.

3.35. ***The potential to link tree crop insurance with replanting loans under the SADP should be explored further***. In this instance, PNG Sustainable Agricultural Development, SADP, which owns PNG Microfinance Ltd is collaborating with OPIC (Oil Palm Industry Corporation) and the World Bank on the Small Farmer Agricultural Development Project to provide replanting loans to smallholder oil palm producers working with Hargy Oil Palm Ltd, Higaturu Oil Palm Ltd and New Britain Oil Palm Ltd. The smallholder credit facility was established in 2010 with a fund of about K 10 million and PNG Microfinance Ltd is seeking to protect these replanting loans against natural and climatic perils by some form of crop insurance (PNGSDP 2011). For insurers the automatic bundling of credit and insurance would result in very much reduced marketing, promotion and transaction costs for insurance.

3.36. ***With indicative sum insured values of about US$ 2,000 per hectare for oil palm***, the total values for smallholder oil palm could be in the order of US$ 32 million for Popondetta and Milne Bay only, but if cover was expanded to include perils such as fire and possibly volcanic eruption, the total value for all 58,060 Ha of smallholder production would be in the order of about US$ 116 million.

Table 3.3. Summary Statistics for Oil Palm Industry, 2007

Location	**Hoskins**	**Bialla**	**Popondetta**	**Milne Bay (Alotau)**	**New Ireland (Lakuramau)**	**Total**
Company	New Britain Palm Oil Ltd	Hargy Oil Palms Ltd	Higatura Oil Palms	Milne Bay Estates Ltd	Poliamba Ltd	
Area Planted (Ha)						
Plantation	34,774	8,909	9,009	11,634	5,689	70,015
Smallholder	25,324	14,580	14,285	1,757	2,114	58,060
Total Area	**60,098**	**23,489**	**23,294**	**13,391**	**7,803**	**128,075**
Number of Blocks						
Land Settlement Scheme (LLS)	2,350	1,851	929	Nil	Nil	5,130
Village Oil Palm (VOL)	4,471	1,593	5,191	536	648	12,439
Production fresh fruit bunch (tonnes)						
Plantation	744,271	180,122	170,206	239,516	117,896	1,452,011
Smallholder	368,729	159,020	162,846	10,376	18,448	719,419
Total production	**1,112,999**	**339,142**	**333,052**	**249,892**	**136,344**	**2,171,430**

Source: Bourke and Harwood 2009. Most figures refer to 2005 to 2007

3.37. ***In the case of rubber, there may also be opportunities to offer named peril damage-based cover to the smallholder North Fly Rubber Ltd (NFRL) community scheme in Western Province.*** Rubber is a minor cash crop in PNG, but it is also a high value tree crop which is very susceptible to fire and windstorm damage. Since 2004, PNGSDP has been financing the Lake Murray Village Rubber Project, Western Province. This rubber nucleus estate and outgrower scheme has assisted 1,646 smallholders in 21 villages in Lake Murray to plant 2,200 Ha of cloned hybrid rubber trees. The project is implemented through North Fly Rubber Ltd (NFRL) which is a partnership between the rubber farmers and PNGSDP. The total value of the project is K15.5 million divided into K9.8 million of development grants for planting rubber and K5.7 million in grower sustenance loans. The repayment terms of the loans are over 10 years[18]. There are now

[18] The loans are up to K3,000 per hectare of rubber and cover establishment and maintenance costs to production.

ambitious plans to expand rubber production in the areas of Agrim in North Fly, Balimo in Middle Fly and Suki in South Fly. (PGNSDP 2011)[19].

3.38. ***There appears to be some scope to develop named peril fire and windstorm insurance cover for North Fly Rubber Ltd farmers.*** Western Province has a very high incidence of wild fires and also it is subject to localised windstorm (tornados). The southern part of Western Province is occasionally hit by the tail end of Tropical Cyclones as they track E-W through the coral sea. The levels of damage incurred to smallholder rubber plantations since 2004 are apparently very low. This does not exclude the fact the very infrequent but potentially catastrophic losses might impact on grower's ability to repay their loans and to rehabilitate their rubber plantations.

3.39. ***In PNG damage-based wind storm (plus fire) growing tree insurance cover should be technically feasible for oil palm trees, rubber trees and other tree crops such as cocoa. The technical and operational considerations for designing and implementing windstorm cover for tree crops in PNG include*:**

1) A formal crop insurance demand study would need to be conducted with the oil palm and rubber sectors. A key issue will need to be addressed namely whether this cover is to be provided on a purely voluntary farmer by farmer basis or whether the nucleus estates wishes to promote an automatic cover for all smallholder growers, or at least those who are recipients of planting and replanting credit.

2) Careful consideration would have to be given to the range of named perils insured under the windstorm policy. Apart from windstorm, there is likely to be demand for fire cover, and possibly flood and volcanic eruption. If underwriters in PNG were to consider fire, this would have to be subject to very tight controls and fire management plans to demonstrate fire prevention, detection and suppression measures. Flood is an extremely difficult peril to insure under a damage-based crop insurance policy, especially in tree crops, and it is very unlikely underwriters will agree to insure this peril in the start-up phase of any new crop insurance program in PNG. In much of PNG there is a marked exposure to volcanic eruption and there may be demand from the cash crop (oil palm, rubber, cocoa) sectors for this cover. In East New Britain, however, the Insurance industry does not underwrite earthquake and volcanic eruption because of the very high exposure to these perils. PNG underwriters would need to be involved at an early stage in identifying and approving the range of perils to be included under a windstorm plus named peril cover.

3) In order to design and rate a windstorm (plus fire and possibly other named perils) cover for small-holder oil palm and rubber plantations and to set deductible levels, it would be necessary to access industry historical windstorm (and fire) damage data for each smallholder holding in terms of the percentage damage (no of trees or area in hectares) for the past 10 to 15 years, or as many years as possible. It is not known whether the nucleus estates maintain detailed damage data-bases and if this information does not exist, it may then be necessary to conduct a grower census to elicit this data.

4) To analyse historical daily windstorm data for the nearest weather station(s) and also the South Pacific TC record by event for each locations to establish the frequency and severity of the localised windstorm hazard and the exposure to Tropical Cyclones. For each recorded event an attempt would be to relate the event to the historical damage

[19] PNGSDP, 2011. Annual Report 2010.

record. A similar exercise should be conducted for rainfall and temperature and relative humidity to examine the fire risk exposure if this peril is requested by the farmers.

5) It would be necessary to obtain grower registration and farm location details for the oil palm and rubber smallholders who would participate in the windstorm insurance scheme and to obtain an up-to-date count of the number of oil palm and rubber trees per holding. This should be a relatively easy task as it is understood the estates maintain individual grower and block production records in their databases.

6) It would be necessary to design a suitable oil palm growing tree windstorm (and fire) insurance policy wording and to get this approved by the PNG Insurance Commissioner, local insurers and their reinsurers.

7) The possible roles of the estates on this windstorm insurance scheme would need to be agreed, but these might centre on the provision of grower registration details, premium collection and payment to the Insurer(s) and in notifying losses to insurers.

8) The most important task would be to assist the PNG insurance sector to design standardised damage-based loss assessment procedural manuals for assessing windstorm (and fire) losses in oil palm trees and in rubber trees and to then train a small network of local "On Call Assessors" or part-time assessors who can be called on in the event of a major windstorm event. In this context there is considerable international experience in the design and implementation of low cost windstorm damage assessment procedures for smallholder tree crops, including the WINCROP[20] windstorm and volcano insurance scheme in the Windward Islands.

Opportunities for Individual Farmer Micro-level Tropical Cyclone Insurance for Oil Palm, Rubber and Cocoa

3.40. ***In PNG it may also be possible to design a Tropical Cyclone Index-based crop insurance policy for individual oil palm, rubber and cocoa farmers, as an alternative to a named peril damage-based windstorm policy.*** Key potential advantages include the fact there would be no need to collect wind damage statistics for the past 10 to 15 years from individual growers as the policy would be triggered by a Tropical Cyclone Index and in this case there is a very good history of tropical cyclone tracks which have affected PNG for the past 50 years or more. In addition, as payouts would be triggered according to a Tropical Cyclone wind speed index, there would be no need to design windstorm damage loss assessment procedures and to then implement in-field damage assessment. The major disadvantage of a Tropical Cyclone Index is likely to be basis risk namely, the difference between the payouts as determined by the TC index and the actual windstorm losses/payouts at the individual farmer location. A particular issue for a windstorm only index is that it does not protect against excess rain and flooding which is often associated with Tropical Cyclones and which can lead to major damage to agriculture.

Key Features of a Tropical Cyclone Index Insurance Cover

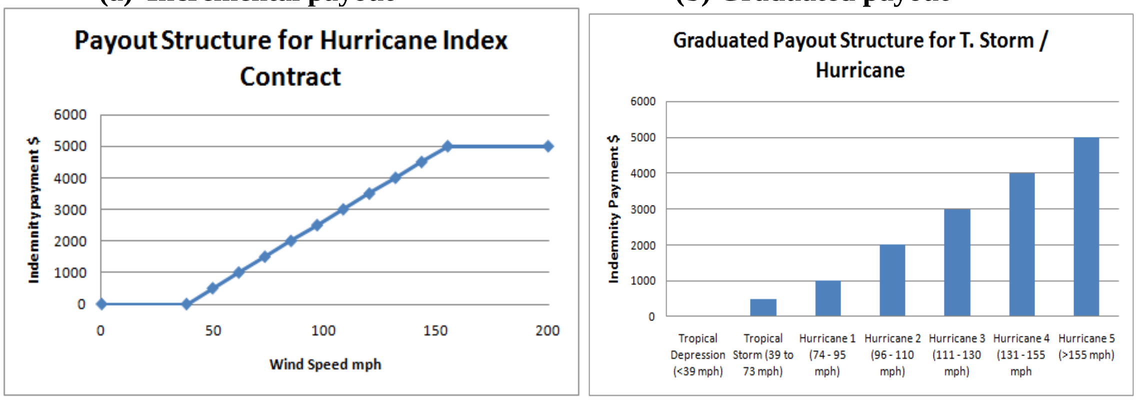
3.41. ***A Tropical Cyclone (Tropical Storm and Hurricane) Index is based on wind speed as measured at a named meteorological stations and a pre-agreed indemnity payout structure for increasing wind speeds***. Normally wind speed is defined in terms of the maximum sustained wind speed of the Tropical Cyclone at its closest point of track to the insured location. The principles of a wind speed index are illustrated in Figure 3.2. where indemnity payments are triggered when sustained wind speed exceeds a specified level termed the "Threshold" or

[20] Windward Islands Crop Insurance (1988) Ltd, WINCROP

"Strike", in this case 39 mph which is the threshold wind speed for Tropical Storms as defined by the Saffir-Simpson scale. The policy can be structured to pay an incremental indemnity for each defined increase in wind speed, for example $ 43 per mph as in Figure 3.2.a. The "Limit" or "Exit" point defines the maximum payout of the policy at a specified wind speed which in the case of the example in Figure 3.2.a would be $5,000 at a wind speed of 155 mph or greater (Category 5 Hurricane, Saffir-Simpson scale). The alternative payout structure is a graduated indemnity system for each wind speed band from Tropical Storm through to category 5 Hurricane as shown in Figure 3.2.b.

Figure 3.2. Optional Indemnity Payout Structure for Tropical Storm and Hurricane Index Insurance

(a) Incremental payout **(b) Graduated payout**



Source: Authors

International Experience with Tropical Cyclone Insurance

3.42. ***Currently there are very few WII programs which insure catastrophe wind storm (tropical storm and hurricane) using a wind speed index.*** At **a micro or individual farmer level** the only commercial tropical cyclone index to date was launched in 2009 in the Philippines, by Malayan Insurance Company in conjunction with MicroEnsure for rice farmers in Region VI. This policy had a dual payout trigger system (a) distance of the wind storm at its closest point of track to the insured location and (b) maximum sustained wind speed at the closest point of track. (discussed further below). In 2010 the World Bank conducted a preliminary risk assessment and feasibility study of the potential to introduce a tropical cyclone micro-level (individual farmer) insurance cover for the fruit and vegetable sector in Samoa. This study was conducted as part of the Pacific Regional Work Plan of the All ACP Agricultural Commodities Programme (AAACP), which is being funded by the EU. In Mexico, Agroasemex since the early 2000s has developed **meso-level** composite drought, excess rain and hurricane wind index covers. At a **macro-level**, the Caribbean Catastrophe Risk Insurance Facility, CCRIF, has since 2006 insured 16 Caribbean Island governments against catastrophe damage to public sector infrastructure caused by earthquake and hurricanes (this program does not specifically insure against losses to agriculture). CCRIF differs from the simple wind speed index outlined above in that it uses probabilistic catastrophe risk models to estimate the expected damage over the geographic area affected by the footprint of each windstorm event[21]. Research is also being conducted into macro-level hurricane index insurance by the World Bank in 2012 in the Dominican Republic. Finally, the major work

[21] For an up to date review of CCRIF see CCRIF 2011. CCRIF a Natural Catastrophe Risk Insurance Mechanism for the Caribbean. A collection of Papers, Articles and Expert Notes, Volume 2, November 2011. Available at http://www.ccrif.org/

conducted under the recent World Bank financed Pacific Catastrophe Risk Assessment and Finance Initiative (PCRAFI) means that the Tropical Cyclone hazard exposure has been fully modelled and mapped for PNG[22] and in future could form the basis of an insurance program for the agricultural sector at macro-level and possibly micro-level.

3.43. ***In the Philippines a pilot micro-level, individual farmer WII program for typhoon (Tropical Cyclones) was designed in 2009 by the Malayan Insurance Company in association with MicroEnsure.*** The Typhoon Weather Index was a satellite based insurance product which was designed by MicroEnsure using typhoon data supplied by the Japanese Meteorological Authority (JMA). MicroEnsure employed the services of an international actuary to conduct a Typhoon risk modelling and mapping exercise for all of the Philippines and to define homogeneous risk-rating zones (28 km grid squares) for the entire country – typhoon premium rates have been calculated for each grid according to the frequency and severity of the tropical cyclone/typhoon hazard. The product was operated by the JMA satellite tracking system for typhoons and an insurance payout was triggered if the typhoon tracked within a defined distance (maximum of 140 kilometres) from the insured farm location(s) and according to the maximum sustained wind speed at the closest point of track: at Strong Tropical Storm wind speeds the policy pays out 15% of the maximum sum insured and at Hurricane 4 wind speed, the payout is 100% of the sum insured (Figure 3.3.). The location of each insured farm was plotted using GPS and the actual payouts were automatically calculated according to how close the farm was to the centre of the typhoon's path and the calculated wind speed at the location[23]. Further details of the Typhoon product and the indemnity formula for wind speed and distance from the typhoon track are presented in Martirez 2009.

3.44. ***The Micro-level Typhoon Index Insurance Cover was launched for rice farmers in Panay Island, Region VI of the Philippines in 2009/10 but operated for one season only before being withdrawn on account of concerns over basis risk.*** The typhoon index was approved in 2009 by the Insurance Commission. The typhoon index was underwritten by the Malayan Insurance Company with reinsurance protection from PartnerRe (formerly ParisRe prior to 2010). The program was launched on a pilot voluntary basis for rice farmers in Panaya Island and in 2009/10 a total of 446 farmers purchased cover for about 650 Ha of rice. The program was free of claims in 2009/10, but was withdrawn by Malayan Insurance Company on account of concerns over basis risk at the individual farm level.

[22] See PCRAFI (2011). PNG Country Risk Profile including risks maps showing the geographic distribution of Tropical Cyclone Hazard, underlying exposure maps showing value of assets at risk and model outputs in terms of the annual expected losses and catastrophe losses for different return periods.

[23] See MICROENSURE 2009: "MicroEnsure is the world-first typhoon weather index insurance for smallholder Philippines rice farmers". http://www.microensure.com

Figure 3.3. Malayan insurance Individual Grower Typhoon Index policy payout structure

Wind speed payout parameter:

Tropical cyclone classification (Saffir Simpson Scale)	Wind speed (mph)	Malayan insurance (MicroEnsure) wind speed payout factor (% of policy limit)
Tropical depression	0–38	Nothing
Tropical storm	39–58	Nothing
Severe tropical storm	59–73	15%
Hurricane 1	74–95	40%
Hurricane 2	96–110	60%
Hurricane 3	111–130	80%
Hurricane 4	131–155	100%
Hurricane 5	>155	100%

Distance of farm from hurricane centre payout parameter:

100 km	100%
Between100 km and 140 km	$\frac{140 - \text{distance}}{140 - 100} \times 100\%$
Over 140 km	Nothing

Source: Martirez, 2009.

Issues and Challenges for PNG

3.45. ***In PNG Tropical Cyclone (TC) data is readily available for more than 50 years and as a major TC risk assessment and rating exercise has been recently conducted for the country under the PCRAFI initiative, in principle it should be feasible to design and rate a TC policy for the cash crop sector (e.g. oil palm, rubber, cocoa etc) in PNG.***

3.46. ***Basis Risk is likely to be very high for any individual farmer general crop tropical cyclone index.*** Different crops exhibit different susceptibility to windstorm damage. Bananas are extremely susceptible to damage at very low wind speeds: in the Caribbean, insurance experience over the past 30 years shows that approximately 50% of all the value of damage occurs at wind speeds of less than 39 mph (the threshold for Tropical Storms). Conversely oil palm is an extremely robust crop and once the crop has reached full stand maturity, significant damage to trees will only occur at Hurricane wind speeds (74 mph and greater). Rubber and cocoa trees are considerably more susceptible to windstorm damage at lower wind speeds than oil palm. In the design of any TC index cover for PNG it would be necessary to conduct a technical study to determine the threshold wind speeds at which damage starts in each crop type and the exit wind speed when maximum damage would be incurred. There is, however, likely to be a major problem of basis risk under an individual grower TC Index, not least because of the very variable topography in much of PNG.

3.47. ***Often the main cause of crop damage due to Tropical Cyclones is not caused by mechanical wind damage, but rather by the torrential excess rain and flooding associated with the Typhoon.*** A wind speed index can only act as a proxy for crop losses due to excess rain, flood, storm surge and salinization of soils associated with a Tropical Storm or Hurricane. There is a potential for very high basis risk where a Tropical Depression tracks over the insured location, but as the wind speeds are lower than 39 mph (the Threshold for a Tropical

Storm/Hurricane) there would be zero indemnity. However, the Tropical Depression may slow moving and associated with very high rainfall levels which lead to extensive flood damage and which would not be indemnified by the Typhoon product. One partial solution to this problem may be to combine a wind speed index with an excess rainfall index product.

3.48. ***In the context of PNG the issue of flood basis risk is potentially so high that it is not therefore recommended to consider an individual grower (micro-level) TC Index for the cash crop sector in any start-up phase of any new crop insurance program***. Conversely, it may be feasible to construct a macro-level Tropical Cyclone Index for GoPNG which would be designed to trigger timely contingency payouts for emergency relief and early recovery operation in the event of severe TC damage such as occurred under TC Guba in 2007

3.49. ***Finally, the option of forming a South Pacific Tropical Cyclone Crop index pool insurance programme along the lines of the CRRIF in the Caribbean and the proposed PCRAFI fund for the Pacific Islands could also be considered.*** The options of a pool scheme include the greatly reduced costs of underwriting the scheme through a single underwriting entity (company), as well as the cost savings in the purchasing of reinsurance protection under a pooled programme. (See Chapter 4 for further discussion).

Opportunities for National Macro-Level Food Security Crop Weather Index Insurance Programs

3.50. ***This section reviews opportunities in PNG for a macro-level food security drought index insurance cover which would be designed to insure against major 1 in 20 to 1 in 50 year droughts*** such as the 1997 ENSO El Nino related drought year and which resulted in major food crop failure in much of the country.

International Experience with Macro-level food security covers

3.51. ***To date, several countries including Ethiopia, Malawi and Mexico have designed macro-level rainfall deficit index insurance covers*** that have been designed to provide governments with immediate cash liquidity following a natural disaster and to enable the government to provide an early response. In addition, the World Food Program (WFP) is currently drawing up ambitious proposals for an Africa-wide Drought Index Insurance Pool which would act as an-ex ante food security instrument for national governments. There appears to be considerable scope for using macro index products as a social safety net product for small subsistence farmers for whom commercial crop insurance is not necessarily an appropriate or cost-effective mechanism.

3.52. ***From a technical design viewpoint, the main advantages of a macro-WII or remote sensing product include***: (i) the issue of basis risk is greatly reduced for an aggregate-national level catastrophe weather index program which is triggered by a basket of selected weather stations; (ii) the costs of client awareness and education, underwriting and policy issuance costs and premium collection are greatly reduced as a single policy is issued to government (as opposed to large numbers of individual small farmers), and (iii) in the case the policy is triggered leading to a payout a lump sum payment can be made to government which is then responsible for the costs of distributing payments to the targeted beneficiaries.

3.53. ***There are several key advantages of using weather index insurance as an ex-ante emergency food security instrument over the more conventional ex-post disaster relief programs*** which are implemented by most national governments including:

- The costs of the Insurance premium (and the maximum financial payouts) are known in advance by the government (the Insured) and can be financed out of the annual budget and or through donor funding. This is in direct contract with ex-post disaster relief funding which is extremely difficult to budget with any accuracy

- In the event the policy is triggered, the Insurer can provide timely and assured payouts which can be used by the government and or relief agencies to finance immediate purchases of emergency food and other types of assistance. This is in contrast to the delays which often result following a major event when the local government and relief agencies must first appeal for financial and food assistance from the international community and donors

- Where the intended or target beneficiaries (e.g. rural households, farmers etc) have been carefully identified and a sum insured pre-agreed for each beneficiary, in the event the policy is triggered for a particular region or regions, this provides the ability to make rapid indemnity payments to the effected households according to the pre-agreed indemnity formula. This is in direct contrast to the ad hoc disaster relief compensation payments which are often made following major natural disasters

- The earlier relief arrives at the individual farmer level after a shock, the greater its effectiveness in mitigating the adverse welfare impacts including the distress sale of assets and speeding up recovery. ARCPT (2011) note that timely assistance before people sell their assets creates five times more value to vulnerable populations than traditional aid which is raised after the disaster occurs and which arrives much later: in Africa they conservatively estimate that an ex-ante contingency fund of US$ 250 million could save African countries and donors nearly US$ 1 billion in cash

3.54. ***Ethiopia represents the earliest macro-level rainfall deficit index that was specifically designed as an ex-ante food security instrument***. The program was designed by the WFP based on a basket of 26 representative weather stations distributed throughout the country. The drought policy was designed to trigger a small but timely cash payment of US$ 7 million to the Government of Ethiopia in the event of drought being trigger in order to purchase emergency food supplies for rural households in the affected areas. (See Box 3.3 for further details).

Box 3.3. Ethiopia Macro-level Rainfall Drought Insurance Index (2006)

Ethiopia. In 2006 the WFP with technical assistance from the World Bank's CRMG, designed a macro-drought index policy for the Government of Ethiopia which was designed as an ex-ante food security risk financing instrument to fund emergency food aid. A national agricultural drought index contract was constructed on the basis of historical rainfall data for 26 weather stations and showed a very high degree or 80% correlation between major catastrophe drought years and requirements for disaster food aid in the drought affected areas. In 2006, the drought insurance cover was placed as a derivative contract with Axa Re with a Total Sum Insured of US$ 7.1 million which was designed to provide emergency relief funding to 62,000 households in 10 to 15 of the most drought affected administrative districts of the country. USAID funded the insurance premium of US$ 930,000 (implied premium rate of 13%). In 2006, seasonal rainfall was above the level which would trigger an indemnity payment and therefore there was no claim on the contract. The program was not subsequently renewed but the experience has been used to improve and strengthen the early famine warning systems in Ethiopia

Source WFP 2006.

3.55. ***The Malawi Macro-level rainfall-deficit index product was launched in 2008 and is linked to expected national maize production as part of Malawi's overall risk management and food security strategy***. Malawi is very prone to droughts and in these years the production of maize is often very reduced forcing government to intervene in purchasing maize imports. The index uses rainfall data from 23 weather stations throughout the country and is based on the Government's own national maize yield forecasting model which in turn is based on the FAO's water balance crop model[24]. In 2008, the macro-drought index for maize was placed as a derivative contract with the World Bank Treasury and backed by reinsurance from a leading reinsurer. The index was constructed such that if the index fell to 10% below the historical average, the Government of Malawi would receive a maximum payout of up to US$ 5 million. The contract has been free of claims in 2008/09, 2009/10 and 2010/11 which were all years with good rains and with no payouts. An innovative feature of the Malawi maize drought index program is the linking of drought index payouts with a "price hedge" call option for white maize which is placed with the SAFEX Commodity Derivatives market, Johannesburg Stock Exchange (Alderman and Haque 2007; CRMG 2008).

3.56. ***The Mexican Catastrophe Climate Contingency Insurance Program (CADENA) is a state level index insurance program that was launched in 2003 to replace the national disaster relief program with a formal parametric insurance program***. The program is targeted at small subsistence crop and livestock producers in each state who are below the threshold of insurability to be considered under the commercial agricultural insurance programs. It is a more comprehensive index program than either the Ethiopia or Malawi programs in that it covers both crops and livestock and uses a range of index product types including weather indexes against drought, excess rain/flood, frost and hurricanes and all risk Area yield indexes and finally NDVI indexes for livestock-pasture insurance. See Box 3.4 for further details.

Box 3.4. Mexico. National Catastrophe Climate Contingency Agricultural Insurance Program for Crops and Livestock

Since its introduction in 2003 the Mexican catastrophe climate contingency insurance program has been massively scaled-up with the development of index products based on i) WII covers against drought, hurricane and frost, ii) AYII covers providing all risk loss of yield protection at a macro-level, and iii) NDVI-pasture index covers for livestock producers. Currently 30 of the 38 state governments in Mexico purchase climate contingency protection; for crops, 8 million hectares are insured with 3.2 million small subsistence farmers protected under the crop insurance programs and about 4.4 million head of livestock are insured under the NDVI pasture drought index program

Source: SAGARPA 2010

3.57. ***The African Risk Capacity (ARC) Project Drought Index project is a proposal for a pan-African owned Pool Index Insurance Fund to underwrite catastrophe weather events, initially to cover drought, but which in future would be expanded to include other weather risks such as flood*** This is a joint Africa Union Commission (AUC) and WFP initiative. The objective of the Insurance Fund would be to provide national governments with immediate cash payments for food security purposes. The benefits of establishing an African Pool Index scheme centre on the fact that drought does not correlate simultaneously across all 42 African countries north and south of the equator providing the opportunity to diversify risk through Pooling. Under

[24] The FAO's model is based on the Water Requirement Satisfaction Index (WRSI) which is used to determine the level of water stress endured by a crop during its whole growing season and the expected yield response to water stress.

this project, AUC/WFP have developed a rainfall risk assessment model (termed AfricaRiskView) which uses historical satellite rainfall data for each country to model the drought risk hazard on a country by country basis for risk quantification and rating purposes and this is combined with data on vulnerable populations to form a standardised approach for estimating response costs to drought. The reason for using gridded satellite rainfall data is that in many parts of Africa there is inadequate coverage of historical rainfall by ground weather stations. This program is due for launch on a pilot basis in 2013 (ARCPT 2011). (See Annex 11 for further details of these macro-level food security index programs).

Opportunities for PNG – Based on Satellite Rainfall Grids

3.58. ***In PNG there appears to be an opportunity to design a Macro level drought index insurance program as a food security instrument to be triggered in catastrophe ENSO El Nino drought years***. It is recommended that this program is targeted at PNGs small subsistence food crop farmers.

3.59. ***Due to the lack of ground-based weather stations / lack of time series rainfall data in PNG, the most appropriate solution would be to use historical satellite rainfall which is available for the past 20 years for all PNG.*** According to the Remote Sensing Unit, UPNG, the most appropriate satellite rainfall data sensor for PNG is the Tropical Rainfall Monitoring Mission (TRMM) which is jointly funded by NASA and the Japan Aerospace Exploration Agency. The TRMM satellite was launched it 1997 and primarily uses microwave imaging to measure the amount of rainfall in the atmosphere. TRMM has now been operating since 1998 (15 years) and can provide rainfall estimates up to 16 times a day (every 90 minutes) at a resolution of 5.1 km2 (2,500 hectares)[25].

3.60. ***Under a future feasibility study, it would be necessary to establish homogeneous satellite rainfall maps for PNG and to decide on the size of the Insurance units for the purposes of rating the product and triggering rainfall deficit payouts.*** Other tasking will include to establish underlying physical and financial exposure maps for PNG based on the density of population and or intensity of smallholder agricultural food cropping throughout the country and in order to estimate the sums insured and maximum payouts under a food security insurance program. This exercise will be able to draw on the experience of the PCRAFI risk mapping exercise for PNG.

Opportunities for Livestock Insurance in PNG

3.61. ***Main Types of Livestock Insurance Products available***

3.62. ***The international insurance market for livestock is much smaller than the crop insurance market*** accounting for about 12% of the total global agricultural insurance premiums written in 2010. The classes of animal which can be insured under a livestock insurance policy include cattle and water buffalo, sheep and goats, pigs, horses and donkeys, pets (cats and dogs), poultry and aquaculture.

3.63. ***The types of livestock insurance policy available are listed in Box 3.5***. The most common form of livestock cover is **individual animal mortality** cover which insures losses

[25] For further information on TRMM see: http://disc.sci.gsfc.nasa.gov/precipitation

arising from death and accidental injury due to natural causes such as fire, lightning, flood etc. Additional coverage can sometimes be purchased for veterinary expenses, transport and non-epidemic/non contagious diseases. Exclusions usually include all epidemic diseases, theft, and loss of economic use of the animal. The sum insured is usually based on the market value of the animal and this reduces over time according to the age of the animal. For individual animal insurance, premium rates range from 1.5 percent to 10 percent of the sum insured based on the type of animal, its age, location and the functions it performs. For individual animal cover, deductibles range from no deductible to a coinsurance on the value of the claim of between 10% and 20%.

3.64. ***In some markets, All risk Livestock Mortality Insurance is available and in a few countries specialist Business Interruption Cover is available for Class A epidemic diseases*** of cattle, pigs and poultry, albeit on a very selective basis.

3.65. ***Livestock mortality index insurance is a very new form of livestock insurance*** that has only been piloted in Mongolia to date. It may have potential for development in countries where livestock production is exposed to catastrophic losses and where national livestock census data and catastrophe mortality data can be readily collected and at low cost.

Box 3.5. Typology of Livestock Insurance Products

A. Traditional Indemnity-based Products:

Range of Products	There are a number of livestock insurance products, which range from basic animal Mortality and Accidental Injury covers through to comprehensive All Risk insurance including epidemic diseases. In addition, specialist policies are available to cover loss of animals in transit or at exhibitions, carcass rejection at the slaughterhouse and loss of use through to pet insurance.
Mortality Cover	The most common form of livestock insurance cover is named-peril animal mortality cover. Mortality cover commonly insures against death or accidental injury requiring slaughter due to: suffocation due to machinery breakdown, poisoning & pollution, fire lightning & explosion, flood and windstorm, subsidence and landslide, riot, strike & malicious damage. Standard Mortality cover generally excludes: diseases and especially epidemic disease and all forms of consequential loss and legal liability.
All Risk Cover	In some countries All risk mortality cover is extended to cover named diseases or epidemic diseases, with an accompanying high deductible and or high rates. (E.g. Germany, Czech Republic, Hungary).
Consequential Loss /Business Interruption Cover for Epidemic Diseases	Specialist Policies which are designed to indemnify both loss of animals following an epidemic and also the reduction or loss of income arising out of the ban on sales of animals or animal products (milk, eggs etc) for up to 12 months post-event. (E.g.

	Germany since 1990 and Mexico since 2005).
Bloodstock Insurance	Insurance for high value values (e.g. race horses, semen bulls and prize cows). The insured perils commonly include mortality, disability, infertility, medical treatment and surgery.
<u>B. New Livestock Index Products:</u>	
Livestock Mortality Index Cover	Mongolia is currently the only country offering livestock breeders with a catastrophe winter freeze-index mortality index policy for their livestock.
Livestock Pasture-grazing Index Cover	Several countries including USA, Canada, Spain and Mexico have developed remote sensing (satellite) based NDVI (normalised difference vegetative index) pasture-grazing indexes for livestock producers which are designed to respond to drought-induced degradation of the natural grazing / pasture during the season and to cover the additional costs of purchased feed incurred by the livestock producer.

Source: Based on Mahul and Stutley 2010

Opportunities and Challenges for Livestock Insurance in PNG

3.66. ***In PNG there is very little commercial livestock production and most pig and poultry production is practiced on a subsistence scale by small farmers: there are, however, a few large commercial beef cattle, pig and poultry breeders in the country.*** Under this pre-feasibility study it has not been possible to conduct any form of risk assessment for these two categories (subsistence versus commercial) livestock producer and therefore it is not possible to report on the main risk exposures faced in livestock production or to report on the demand for livestock insurance.

3.67. ***Internationally, livestock insurers prescribe a series of standard pre-conditions for the operation of livestock insurance, but currently few of these preconditions are likely to be met in PNG, at least for subsistence livestock breeders.*** Table 3.4 lists the main preconditions for the operation of a livestock insurance scheme including key conditions such as the tagging of individual animals for identification purposes and registration of all animals. This is a precondition of offering theft cover in livestock. A major requirement for the operation of livestock insurance is the presence of qualified veterinarians who can conduct pre-inspections of each insured animal to certify the animal is in sound health and then in the event of loss to inspect the carcass and to confirm that the cause of death is due to an insured peril. Currently the DAL is constrained by a lack of financial resources and a shortage of veterinary staff. From an insurance viewpoint, if insurance covers named livestock diseases, this is conditional on a disease diagnostic capability in the country – in this case it is understood that the National Agriculture Quarantine & Inspection Service does have an animal pathology unit and can also draw on expert services from Australia if necessary. Finally, in the absence of a formal livestock mortality database, it is very difficult to design and rate a livestock insurance product(s) in PNG.

Table 3.4. Preconditions for the Operation of Livestock Insurance in PNG

Key Pre-conditions for Livestock Insurance:	PNG: Actual situation
Commercially managed cattle, pigs and poultry enterprises and observance of minimum standards of animal husbandry and sanitation.	Most farmers own very small numbers of pigs poultry and sheep and goats for purely subsistence purposes and which are uninsurable
Individual animal identification (tagging) and registration (obligatory for cattle)	No system of individual animal tagging or livestock registration system exists in PNG.
Veterinary pre-inspections to certify animal is in sound health	The DAL Livestock veterinary and extension services are very under-resourced
Animals must be contained within farm boundaries and free-range grazing is not permitted	Many animals are free-range?
Loss notification and inspection procedures must be in place and animal pathology services available.	Restricted number of veterinarians to perform loss inspections. Limited animal pathology services
Mortality data is essential for rating purposes.	No formal livestock mortality databases exist in PNG.

Source: Authors

3.68. ***The possibility of developing Livestock insurance in PNG appears is very limited in the short term, at least for smallholder livestock producers.*** From a technical viewpoint, few subsistence livestock producers are likely to meet the minimum husbandry and sanitary standards required by insurers. Furthermore the very small size of units (a few head of pigs, sheep and goats) would make it prohibitively expensive for insurers to conduct pre-inspections and to appoint veterinarians to adjust losses. There may, however, be some potential in future to develop standard accident and mortality covers for the medium to large commercial pig and poultry breeders mainly located in the Markham Valley area.

Summary of Key Issues and Challenges for Agricultural Insurance Product Development in PNG

3.69. ***On the basis of the pre-feasibility study it is apparent that the potential to develop crop and livestock insurance products and programs is currently fairly restricted in PNG by*** a number of factors including lack of an agricultural insurance culture and functioning market, lack of demand especially by small mainly subsistence farmers, and the lack of crop production, crop damage and weather data on which basis to design and rate such programs.

3.70. ***However, a*** series of potential traditional indemnity-based crop insurance products and new WII options have been identified.

3.71. ***It may be feasible to design a named peril damage-based policy for windstorm (plus allied perils such as fire and volcanic eruption) cover in tree crops including oil palm, rubber and possibly cocoa***. The main technical challenge for this product will be the availability or otherwise of historical crop windstorm and fire damage data at a disaggregated (preferably individual farmer) level in order to set the deductibles and rates on this product. The main operational challenge for this cover will be how to market and distribute this product cost-effectively to smallholder out-growers in PNG and also to design and implement low cost damage-based loss assessment procedures.

3.72. ***Options may also exist for designing and rating a Tropical Cyclone Index for cash crops of oil palm, rubber and cocoa.*** There is a lengthy record of more than 50 years of tropical cyclone data on which basis to design and rate such a product. The main challenge, however, if this product is offered as an individual farmer policy is likely to be basis risk. For this reason this product might be more suited to a macro-level ex-ante emergency relief product for GoPNG.

3.73. ***Finally, options may exist to develop a Macro-level satellite rainfall deficit food security cover*** to provide contingency payments to government in years of severe ENSO El Nino drought related food shortages such as occurred in 1997/98.

3.74. ***In the short term, options for livestock insurance in PNG appear to be very limited***.

Chapter 4: Institutional, Operational and Financial Considerations for Agricultural Insurance in PNG

4.1. Under the Terms of Reference this Chapter reviews the options for an institutional framework based on a public-private partnership for the development of market-based agricultural insurance in PNG, and particularly the financing of agricultural catastrophic losses.

The Insurance Market in Papua New Guinea

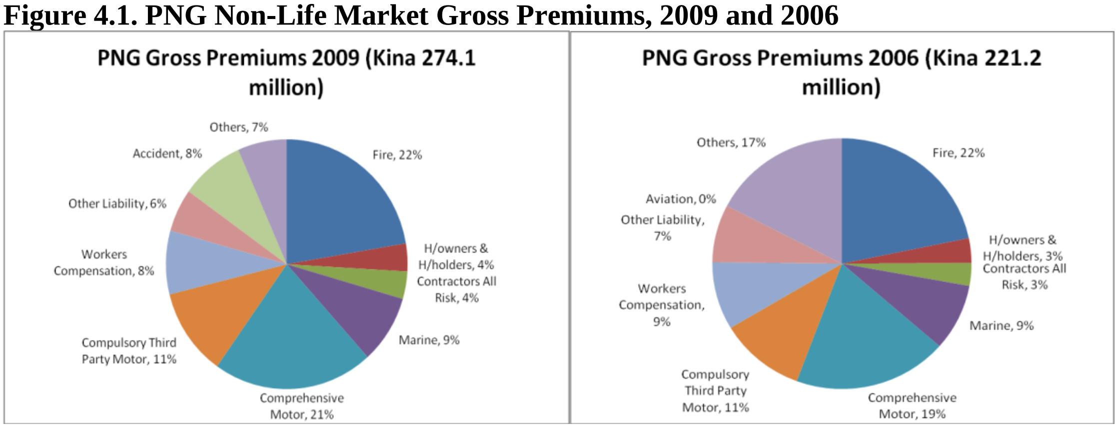
4.2. ***The Insurance market in PNG is regulated by the Insurance Commissioner*** based in Port Moresby and the terms and conditions of insurance business are governed by the Insurance Act No 23. Of 1995 which is based on British Law. There is also an Insurance Association which acts on behalf of its private commercial members.

4.3. ***There are 12 non-life direct insurance companies operating in PNG in 2012*** of which the largest by share of market premium is QBE, followed, by Pacific MMI, Pacific Assurance Group, and Chartris. The mainstream insurance brokers including Aon and Marsh operate in the PNG Market. Specialist loss adjusters include Crawford's Loss Adjusters.

4.4. **Market penetration rates are currently very low**. For example only about 5% of the domestic property market is insured in PNG and there is a low culture of insurance purchasing save for compulsory insurance (e.g. motor vehicle third party liability). The life insurance market in PNG is very small with total premiums of only K22 to 25 million and shrinking

4.5. **The non-life (general) insurance market is currently writing about Kina 330 million original gross premium in 2011**. Reference to Figure 4.1 shows the market has increased from K 220 million in 2006 and K 274 in 2009. The main classes of non-life business include Property Fire insurance and Comprehensive Motor vehicle insurance each accounting for 22% of gross premiums in 2009. The non-life business has been profitable over this period with an overall loss ratio of between 44% and 42% in 2006 and 2009.

Figure 4.1. PNG Non-Life Market Gross Premiums, 2009 and 2006



Source: Insurance Commissioner March 2012

4.6. ***The PNG non-life market underwrites most line of general insurance business with few restrictions***. However, earthquake and volcanic eruption are excluded from policies issued in East New Britain.

4.7. ***The traditional reinsurance market for PNG was Lloyds of London.*** There is one local reinsurer in PNG, PacificRe. Today the market is opening up and MunichRe has started reinsuring PNG treaties. SwissRe has not yet entered the market. The role of international reinsurers will be critical to the start-up of any agricultural insurance program in PNG.

4.8. ***No insurance company in PNG is underwriting growing crops agricultural insurance in 2012,*** but some companies offer post-harvest transit and processing and storage insurance to the large estate processors/exporters (oil palm etc). There is also some limited cover for commercial poultry breeders which covers fire and allied perils for loss or damage to the chicken sheds and their contents.

4.9. ***Several of the Non-life Insurance Managers have a good knowledge of the international agricultural insurance market and the products that are available.*** Many of the company underwriters and broking community have direct experience of the Australian insurance market which is one of the world's most competitive crop, livestock and forestry insurance markets. This knowledge will be very useful under any future initiative to introduce agricultural insurance into PNG.

4.10. ***The non-life insurers identified the cash tree crop export sector as being the most likely sector to purchase crop insurance in any start-up program in PNG.*** The insurers identified smallholder out-growers attached to the oil palm estates as being the best organized of the cash crop sectors and therefore the most suitable for insurance. Cocoa and coffee are predominantly smallholder crops today and fewer farmers are members of nucleus estate out-grower schemes.

International Experience with Agricultural Insurance

4.11. ***It is expected that if agricultural insurance is to be introduced into PNG that some form of Public-Private Partnership, PPP, arrangement will be necessary*** because private commercial insurers are unlikely to be willing to bear all the high start-up costs associated with a new agricultural insurance program and especially if GoPNG wishes to target this program at small and medium commercial farmers.

4.12. ***This section briefly reviews some of the features of government support to PPPs in agricultural insurance drawing on international experience.*** This section draws on a World Bank 2008 survey of agricultural insurance provision in 65 countries which examined the role of the public sector support for PPPs in agricultural insurance (Mahul and Stutley 2010). Further details on the roles of government are presented in Annex 12.

4.13. ***The 2008 World Bank survey of 65 countries showed that levels of government support to agricultural insurance was extremely high in both the developed and emerging and low income countries***. The most common forms of government support included:

- *Premium subsidies* which applied to two thirds of the surveyed countries (63% of countries with crop insurance programs and 35% of countries with livestock insurance programs). The provision of crop premium subsidies was similar across regions irrespective of economic status, except for the poorest low-income countries where only 40% provided agricultural insurance premium subsidies. In 2007 agricultural insurance premium subsidies cost governments US$6.6 billion or 44 percent of global agricultural insurance premiums and out of this US$5.8 billion went towards crop insurance premium subsidies;

- *Agricultural Insurance legislation* had been enacted in half (51%) of the surveyed countries: in Europe this was as high as 71% of countries and only 30% in LAC.
- *Government financial support to agricultural reinsurance* applied to one third (32%) of the surveyed countries and was very high in North America (100% of countries), Asia (70% of countries) and Europe (38% of countries): however government support for reinsurance was very low in Africa (13% of countries) and in LAC (5% of countries). In addition, no governments in the Low-income group of countries were involved in funding crop reinsurance which is not surprising given the very high costs of catastrophe claims in agriculture.
- *Administration and Operational (A&O) cost subsidies*. Governments subsidised A&O costs in 16% of the surveyed countries, especially in Asia, and in 6% of countries subsidised loss adjusting expenses.
- *Other forms of government support* included*:* to research, development and training in 44% of the crop programs reviewed and 33% of livestock programs.
- *Overall the total costs to governments of all forms of subsidy* were estimated at 68% of total global agricultural insurance premiums in 2007. *(*Mahul and Stutley 2010*).*

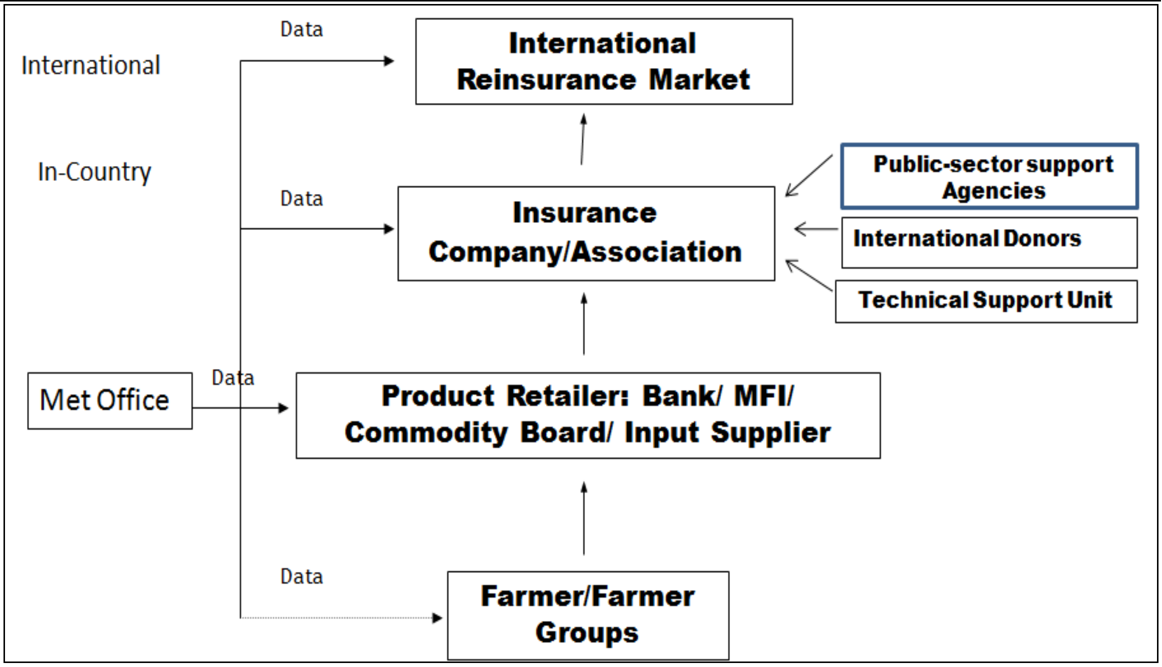
4.14. ***In the Asia-Pacific Region, there is a wide diversity of public sector support for agricultural insurance*** ranging from the completely unsubsidized commercial insurance markets in Australia and New Zealand to the very heavily subsidised programs in China, Japan, South Korea and the Philippines.

4.15. ***The 2008 survey showed that high levels of government support in the form of premium subsidies are not necessarily a pre-condition for high insurance uptake*** and penetration as evidenced by the non-subsidised schemes in countries such as Australia, USA (crop hail) South Africa, Germany and Argentina. Furthermore the study showed that the private agricultural insurance schemes tended to be more profitable that the subsidised programs and which is probably due to the higher commercial pressures to achieve profits on these non-subsidised programs. (See Annex 10).

Institutional Framework for Agricultural Insurance in Papua New Guinea

4.16. ***It is likely that the development of any market-based crop insurance products and programs in PNG will require the active collaboration by the private and public sectors under some form of private-public partnership agreement PPP***. Figure 4.2 presents an illustrative institutional framework showing the relationship between key stakeholders under such a PPP.

Figure 4.2. Illustrative Institutional Framework for Agricultural Insurance in PNG



Source: Author, adapted from CRMG, World Bank

4.17. ***The success of any PPP crop insurance program involves the early identification and then active commitment of key public and private stakeholder organizations which will be involved in the design and subsequent implementation of the program***. Within the PPP Institutional Framework illustrated in Figure 4.2 the key stakeholders will typically include private insurance and reinsurance companies, a rural distributor/agent, government departments, most notably the Meteorological Services, Line Ministries, local agro-meteorological specialists either from research institutes or universities, a TSU and donors. These organisations are listed in Table 4.1 and further comments on the role of each organization are made below.

Table 4.1. Stakeholder Organizations typically involved in Agricultural Insurance Programs

Category	Potential Stakeholder
Local Insurer	Private Commercial Insurance companies Insurance Association
Reinsurers	International Reinsurance companies
Intermediary Channel / Distributors	Agricultural banks, Rural Banks, Cooperative Banks, NGOs, MFIs, Input suppliers, Agribusiness Companies and Outgrower or Contract Farming schemes for export cash crops
Farmers	Farmer associations, cooperatives
Government Departments	Regulator of Insurance Ministry of Finance Ministry of Agriculture Planning Ministries Research and Specialist Institutes Meteorological Agency Climate Change Agency
Technical Support Unit (TSU)	The formation of a TSU is strongly recommended to act as the centre of technical expertise for the design and rating of the

	crop insurance product(s) and to coordinate the planning and implementation of pilot projects in conjunction with the stakeholders
Donors	Technical assistance and pilot project funding

Source: CRMG 2009

Formation of a Steering Committee

4.18. ***In the World Bank's experience it is very useful if the interested stakeholders from the private and public sectors form a Steering Committee. In PNG it is recommended that the steering committee is coordinated through the Office for Climate Change and Development (OCCD)*** because of its central role in climate change adaptation planning in PNG. The main functions of the steering committee would include to:

i. Establish a detailed work plan, timetable and budget for the design and implementation of the pilot agricultural crop and livestock insurance program(s);
ii. Approve the formation and funding of a Technical Support Unit whose key role will be to provide act as the project design and management unit and to provide technical assistance to the insurance company(ies) which intend to insure the crop insurance pilots;
iii. Meet on a regular basis to review progress with the design and planning of the crop insurance pilots and to ensure maximum coordination between private and public stakeholders.

Role of Technical Support Unit

4.19. ***The formation of a Technical Support Unit at the outset of the crop insurance pilot project can be very useful as a mechanism by which the Donor can channel its technical assistance*** (external and local consultants and research and development funding) through the TSU. The TSU can also act as the coordinator for all design and planning activities between the stakeholders. The composition of a TSU might include 2 or 3 staff including for example, a technical project manager, a crop insurance specialist and an agro-meteorologist with modelling skills. A further reason for forming a TSU is to create local expertise in the design and rating and implementation of the traditional crop or CWII products and to provide a technical centre of expertise which can be accessed by local insurers and other stakeholders which are interested in implementing CWII. Currently most of the crop insurance design expertise rests with multinational donors and or specialist reinsurers of this class of agricultural business.

4.20. ***One of the first tasks of the Steering Committee should therefore be to consider the need or otherwise to form a TSU*** to coordinate the technical design and implementation of the identified agricultural pilots programs.

4.21. ***Once a functioning agricultural insurance system is established in PNG decisions could be taken on whether to continue to maintain a standalone TSU or to absorb it into the agricultural insurance structure.*** Once the PNG Insurance Companies have decided on their optimal organisational structure for the new agricultural insurance program(s), decisions could be taken to absorb the TSU into the Insurance company(ies), or to maintain this as a separate entity. If a coinsurance pool agreement is adopted the TSU could conveniently be absorbed into this entity: however, if the insurance companies elect to operate separately and underwrite their own agricultural insurance accounts, there may be a useful role to maintain the TSU as an independent unit serving the technical product and design needs of all the companies.

Role of Insurance Company(ies)

4.22. ***Local non-life insurance companies in PNG need to be included at the outset and to be actively involved in the planning and design of the crop insurance program(s) in order to ensure local ownership and commitment.***

4.23. ***Challenges will be faced in obtaining support from local insurance companies in PNG because they experience in the design and rating and implementation of agricultural insurance***. The insurance companies in PNG do not have rural branch networks capable of delivering and administering cost-effectively, crop insurance products and services to small remote and scattered farmers. It is therefore essential at the outset to demonstrate to the insurer that (a) the design and rating of the weather index product will be based on purely technical and commercial criteria, (b) that the TSU is able to assist the insurer to arrange specialist reinsurance protection for this new class of business and (c) to identify cost-effective ways of marketing and administering a portfolio of small weather risk policies belonging to small farmers.

4.24. ***The primary role of the Insurance Company*** (ies) under a pilot crop insurance program(s) is to underwrite the product(s), to issue the contract(s) of insurance on its (their) own paper, to collect premiums and to settle claims.

Role of Reinsurer(s)

4.25. ***The role of international reinsurance is likely to be important any crop insurance initiative for PNG.*** The reinsurance sector is a major source of specialist technical expertise in the design and rating of agricultural insurance products and it is recommended that the Steering Committee should seek the involvement of lead agricultural reinsurance companies at the earliest opportunity.

Role of Rural Institutions as Distribution Channels for Crop Insurance

4.26. ***In most developing countries the insurance companies do not have retail branch networks in rural areas to market and administer policies to individual smallholder farmers and they therefore need to consider cost-effective distribution channels through existing rural organizations.*** This situation applies to PNG. It is therefore recommended that the Project Steering Committee should actively seek to indentify rural service organizations which actively work with farmers and farmer organization to act as distribution channels for crop insurance including the Rural Banks and Nucleus Estates for export tree crops such as oil palm, rubber, cocoa etc.

4.27. ***International experience shows that new pilot crop or livestock insurance schemes are generally most successful and sustainable where insurance is linked to a wider agricultural development program aimed at providing improved technology, products and services to farmers.*** The bundling of agricultural insurance with agricultural credit and input supply including seeds and fertilizers appears to offer a win-win situation to farmers, rural banks, and input suppliers and should be promoted in PNG wherever possible. Chapter 3 identified the potential linkages between PNG Microfinance Ltd credit provision to smallholder oil palm producers under the SADP Project in Oro and West New Britain Provinces and a tropical cyclone and allied peril cover for oil palm.

Role of Meteorological Services

4.28. ***If Crop WII programs are to be developed for PNG (e.g. for tropical cyclone cover for cash crops or for macro rainfall deficit cover for food crops), the GMA, can potentially play very important roles*** in 1) the provision of time-series weather data for the nearest stations to the cropping areas, 2) collaborating in the design and rating of the pilot weather indexes and then 3) entering into a formal agreement with the appointed insurer(s) to use their weather stations as WII trigger stations and to provide real time weather data during the implementation phase of the CWII contract. As previously noted in Chapter 2, in order for the PNG National Weather Services to operate trigger weather stations for insurance purposes it urgently requires funding to strengthen and upgrade its weather station capability including investment in automated recording stations and funding or staff and other recurrent costs.

Role of Government in Developing Weather Index Insurance

4.29. ***Public-Sector support for a PPP is likely to involve a wide range of Ministries and Departments*** including the Insurance Commissioner, DAL, National Weather Services, Office for Climate Change & Development, etc. Government's specific roles in supporting this PPP initiative through these public-sector institutions are discussed further at the end of this Chapter.

Operational Considerations for Papua New Guinea

Coinsurance Pools in Agricultural Insurance

4.30. ***It is recommended that the commercial insurance companies consider the benefits of forming a coinsurance pool to underwrite crop insurance in PNG.*** In emerging economies where this is no tradition of crop or livestock insurance or rural insurance infrastructure, a pool coinsurance program may be a much more attractive and cost-effective proposition for commercial insurance companies than if they were to try to operate independently. The potential benefits of an Insurance Pool include the ability to underwrite a much broader and larger book of business and the potential to achieve a much better geographical spread of risk, than if the each company were operating independently; economies of scale in the costs of developing new products and programs and in underwriting risks and in adjusting claims where a single lead coinsurer is appointed (or a separate Technical Support Unit is created) to administer the business on behalf of the pool members. There are also major potential cost savings in the purchasing of reinsurance protection for a pooled coinsurance program.

4.31. ***Coinsurance Pools for agricultural insurance have proved to be very popular with private and mutual insurers in many countries*** including most notably, the Agroseguro Pool in Spain, the Tarsim Pool in Turkey, the Philippines livestock insurance pool, the Austrian Hail Insurance pool and various other pool arrangements in China, Argentina, Malawi, Mongolia and Ukraine.

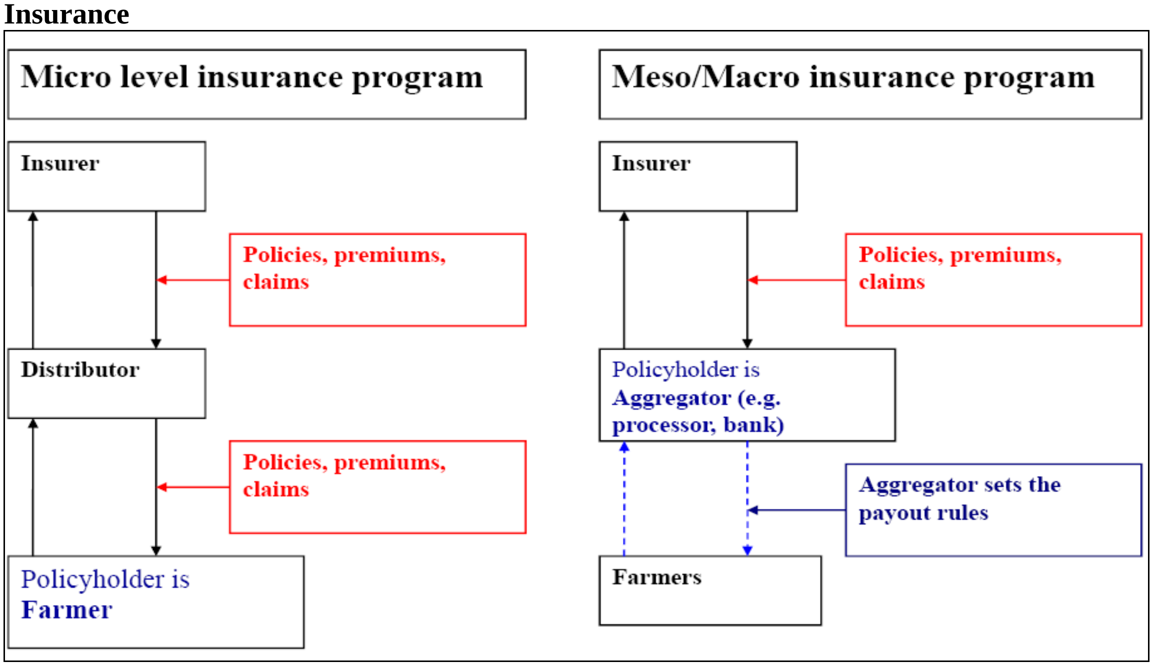
Distribution Channels and linkages with Crop Credit

4.32. ***The local insurance companies will need to identify cost-effective ways of marketing, underwriting, administering and settling claims on potentially large numbers of individual agricultural insurance policies issued to predominantly small farmers in the selected municipalities in PNG.*** As noted previously the insurance companies do not have rural distribution networks or any experience of underwriting small-scale agricultural risks. They will therefore need to identify cost-effective distribution channels.

4.33. ***In many parts of the world public or private sector credit provision to agriculture is protected by a compulsory crop insurance policy (crop-credit insurance).*** From an insurer's viewpoint there are major advantages of automatic or compulsory crop-credit insurance in that (a) anti-section is reduced, (b) there is less need for pre-inspections (c) the costs of promoting and marketing the agricultural insurance program are reduced and (d) the insurance uptake and spread of risk and premium volume is generally much higher than under a purely voluntary program. Examples of compulsory crop-credit insurance schemes include the major crop insurance programs in India, the Philippines, Mexico and Brazil (compulsory for those loans given through Banco do Brasil, state owned bank).

4.34. ***In PNG, options for marketing Index crop insurance under either a micro-level individual farmer program or as a meso-level program through an aggregator such as a rural bank or microfinance organisation should be considered further.*** For example under the PNG Microfinance Ltd credit program for the replanting of smallholder oil palm blocks in Oro and West New Britain Provinces, if a tropical cyclone index policy is developed, this policy could be issued as a meso-level policy to PNG Microfinance Ltd to protect its loan portfolio against default in the event of a severe tropical cyclone causing damage to the plantations: the company would be responsible for paying premiums and in the event of claims would receive any triggered payouts and would then be responsible for deciding on the payout rules to individual farmers who had incurred major losses (Figure 4.3). Such a meso level cover could not, however, operate under a traditional named peril damage based policy issued to individual oil palm growers.

Figure 4.3. Comparison of Organisational Structure for Micro and Meso-Agricultural Insurance



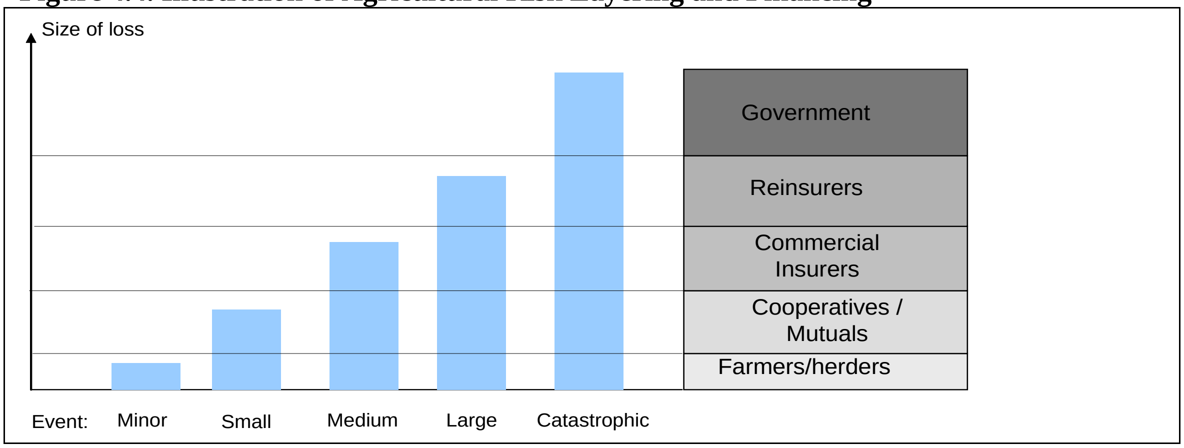
Source: CRMG, World Bank

Financial and Reinsurance Considerations

4.35. ***The international agricultural reinsurance market for traditional and new WII insurance is dominated by a handful of specialist agricultural reinsurers*** including SwissRe, MunichRe, PartnerRe, HannoverRe, NovaeRe, SCOR and RennaisanceRe. In addition to providing reinsurance capacity, several of these reinsurers also play an active role in the technical design and rating and implementation of agricultural insurance products. It is important to involve a lead reinsurer(s) at an early stage in the planning and design stages of any new agricultural insurance programe.

4.36. ***There are many options for structuring risk financing and reinsurance programs including both proportional and non proportional reinsurance***. Figure 4.4. provides an example of a non-proportional insurance and reinsurance structure involving both mutual and private commercial insurers with reinsurance for catastrophe events being provided by international reinsurers and possibly local government.

Figure 4.4. Illustration of Agricultural Risk Layering and Financing



Source: Mahul and Stutley 2010

Role of Government

4.37. ***International experience tends to suggests that implementation of agricultural insurance is most efficient and effectively managed by the private commercial crop insurance sector***[26]**.** However, where insurance markets and infrastructure are poorly developed, governments may have important roles to play in promoting agricultural insurance, particularly in the start-up phases of new private commercial agricultural insurance programs.

4.38. ***Globally many governments provide premium subsidy and or reinsurance support to crop insurance*** as shown in the introductory section to this Chapter. In PNG government's policy towards agricultural insurance has not yet been defined, but Box 4.1. highlights some of the potential roles for government under a PPP to promote and support the introduction of agricultural insurance in PNG.

[26] See for example, Hazell 1992 and Mahul and Stutley 2010.

Box 4.1. Roles for Government in Supporting Agricultural Insurance

Legal and Regulatory Framework. One of the most important functions for government in facilitating agricultural insurance markets is the establishment of an appropriate legal and regulatory framework and where necessary to enact specific agricultural insurance legislation.

Enhancing Data and Information Systems. Time-series data and information on crop production and yields and climate are essential for the design and rating of any traditional crop insurance product or new weather index product. Governments can provide an invaluable service by creating national data bases and to then make these data bases available to all interested private commercial insurers either free of cost, or at concessionary rates.

Product Research and Development. Among the major start-up costs for any new crop or livestock insurance program is the design (including the design of loss assessment procedures) and rating of new products, and then in the pilot testing of the new products and programs. Such costs may be prohibitive for individual private commercial insurers especially in developing countries. In such situations there is justification for government to provide financial support to product design and rating, especially where the products and rates are then made available to all interested insurers.

Education, Training and Capacity Building. Governments can play an important role on new agricultural insurance programs by supporting (a) farmer awareness and education programs and (b) capacity building and workshops and technical training programs for key agricultural insurance staff.

Catastrophe Risk Financing. Agricultural insurance often has to protect against catastrophe perils of flood, drought, and wind storm in crops and epidemic disease outbreak in livestock. Most insurance companies do not have adequate capital to retain their catastrophe risk exposures and they typically purchase some form of contingency financing and or reinsurance protection. For new companies which do not have large amounts of capital and have not yet built up claims reserves, the ability to retain risk is usually low and they typically need to purchase quota share treaty reinsurance and to then seek non-proportional reinsurance protection on their retention. In start-up situations where the insurance company does not have an established track record and loss history the costs of reinsurance protection may be very high. In such situations, government support to the reinsurance program may be highly cost effective.

Public Sector Premium Subsidies. Premium subsidies are the most widely practiced form of government support to agricultural insurance practiced by over two thirds of countries which have some form of agricultural insurance. Governments justify the provision of agricultural insurance premium subsidies on the grounds that they make insurance more affordable for farmers particularly small and marginal farmers thereby increasing the rate of adoption and uptake of agricultural insurance. There are, however, major drawbacks of premium subsidies including the disproportionately benefit larger farmers to the detriment of small and marginal farmers, they tend to promote moral hazard namely to encourage crop production in high risk regions, once premium subsidies once introduced are very difficult to reduce or to withdraw and they represent a major cost to government.

Source: Mahul & Stutley 2010

Chapter 5: Conclusions and Next Steps

5.1. This final Chapter highlights the key conclusions of the pre-feasibility study and identifies the key crop and livestock insurance products which merit further investigation and which might be developed into commercial insurance programs in PNG the near future.

Conclusions

5.2. ***Agriculture in PNG is highly exposed to a range of natural and climatic perils and merits further analysis with a view to designing appropriate crop and livestock risk transfer and insurance solutions***. PNG has a very high exposure to earthquake, tsunami and volcanoes as well as being affected by climatic perils including tropical cyclones and the influence of the ENSO El Nino cycle which brings with it extremes of drought and bush fires and then excess rain and flooding. A recent World Bank funded study estimated that the annual average costs of earthquakes to the PNG economy of US$ 62. 7 million and the expected loss may be as high as US$ 645 million 1 in 100 years and the estimated average annual loss to agriculture (cash crops) is in the order of US$ 13.5 million per annum (PCRAFI 2011).

5.3. ***PNG's agricultural sector is also very vulnerable to the impacts of climate change***. Sea level rise, temperature rise, higher rainfall and possibly more extreme climatic events have the potential to impact adversely in future on agriculture in PNG. In the short temperature increases will increase the altitude that frost prone crops such as sweet potato can be grown: by 2090 temperature increases may be so high as to exceed the heat tolerance of various crops and these will no longer be able to be grown in lowland PNG. Coastal and inland flooding damage export and subsistence food crops as well as the transportation infrastructure (roads and bridges) needed to bring goods to market, cutting off farmers from their sources of income.

5.4. ***The development of any agricultural insurance products and programs must be based on sound risk assessment***. Three main types of data are required to conduct an agricultural risk assessment (i) time series weather data for a minimum of 20 years or more for key variables such as rainfall, temperature, relative humidity, wind speed etc, (ii) time series (10 years or more) crop sown area, harvested area production and yield statistics at national, regional and district levels (and also individual farmer level if individual grower MPCI is to be developed) and (iii) time-series crop damage data and statistics for perils such as fire, hail, frost, flood etc. In the case of livestock, detailed time series data and statistics are required on the types and numbers of livestock by class use and detailed mortality data by cause of loss.

5.5. ***This report has shown that the availability of crop and livestock production data and weather data is very limited in PNG*** and this has therefore restricted the amount of original risk assessment work that could be conducted under this pre-feasibility study. There is, however, a very long history of land use risk mapping for PNG and this data-base and GIS maps will be very useful for any future agricultural risk assessment and rating initiative. In addition, a major World Bank and Asian Development Bank (ADB) financed technical risk assessment and risk modeling exercise has recently been concluded for earthquake and tropical cyclone in PNG under the Pacific Risk Assessment and Financing Initiative (PCRAFI) and the results of this exercise will be invaluable to the future design and rating of Tropical Cyclone cover for cash crops (oil palm etc).

5.6. ***The development of suitable crop and livestock insurance programs in PNG is, in turn, restricted by the lack of weather data and crop production and damage data and livestock production and mortality statistics.*** In the case of weather index insurance, it is necessary to have a relatively high density of recording stations as one station is normally representative of the rainfall regime in a radius of only 20 to 25 kilometers: this report has shown, however, that the PNG National Weather Services has only 14 synoptic weather stations and a further 20 or so rainfall gauges that are currently operating and which can provide uninterrupted historical daily rainfall data for 20 years or more. This density of weather stations would be inadequate to operate a ground-based rainfall index insurance program for farmers in PNG. In the case of food crops the lack of any national system to measure and record sown area, production and yields precludes the design and implementation of either individual grower MPCI loss of yield insurance or Area-Yield Index (AYII). Finally the lack of livestock statistics is identified as a major constraint to the development of individual farmer standard accident and mortality insurance covers.

5.7. ***In spite of these constraints the report has identified a series of traditional indemnity-based and index-based crop insurance opportunities for PNG which merit further research and investigation***. These options include (i) traditional individual grower named peril, damage-based crop insurance for windstorm and allied perils in oil palm (and possibly, rubber, and cocoa) grown in areas which are prone to tropical cyclone damage; (ii) tropical cyclone only index for individual farmers and (iii) a national satellite rainfall-drought index designed to provide GoPNG with timely cash payments in the event of catastrophe drought and which would contribute towards food security in PNG.

37. ***It is likely that the development of any market-based crop insurance products and programs in PNG will require the active collaboration by the private and public sectors under some form of private-public partnership agreement, PPP***. The private commercial insurers do not have the resources to invest in agricultural insurance by themselves and the will need assistance from government and other public and private institutions to establish suitable insurance infrastructure. One major challenge is therefore to define an appropriate agricultural insurance strategy relying on strong public-private partnerships which would include both the private commercial insurers and the Banks/MFIs and other rural service organizations including the export tree crop sector which operates a nucleus estate and smallholder (NES) production model. An institutional framework for an agricultural insurance PPP in PNG is presented in this report.

5.8. ***Under the proposed PPP there are several very important roles GoPNG can play in supporting the introduction of agricultural insurance***. Under start-up situations, such as in PNG, where there is currently no agricultural insurance supply, government can play a very important role in creating a suitable legal and regulatory environment and in investing in agricultural insurance infrastructure including: providing insurers' with access to crop production and weather data and statistics, financial support for the creation of a Technical Support Unit (TSU) to conduct feasibility studies for the design and rating of agricultural insurance programs, investment in increasing the density of automated weather stations through to assistance in the design and training of field-based loss assessment systems and procedures for windstorm and allied perils. Under some circumstances, government's may also provide financial support either in the form of reinsurance of catastrophe claims and or the provision of premium subsidies which are designed to reduce the costs of premiums to farmers, thereby making agricultural insurance more accessible and affordable especially for small and marginal farmers. This report recommends that GoPNG should be very cautious about offering premium subsidies unless these are carefully targeted and budgeted. One exception would be in the case of a meso-level satellite rainfall index product where GoPNG would be the insured and would be responsible for paying premiums.

Next Steps

5.9. The Pre-feasibility study will be submitted to the Department of Agriculture and Livestock (DAL), GoPNG. It is recommended that the report should also be made available to other interested potential stakeholders including the OCCD, Insurance Commission, the PNG Private Insurance Association and its members, the banking and MFI Sectors and key commodity and producer organisations involved in the export tress crop sectors (oil palm rubber, cocoa, coffee etc).

5.10. Depending on the outcomes of GoPNG's review of this report, the next stage would be to implement a full ***feasibility study for agricultural insurance*** which would be designed to address some of the key outstanding issues identified by this initial study including:

(a) To conduct a formal individual ***crop insurance demand study*** with smallholders involved in cash crop production under the nucleus estate, outgrower schemes for oil palm, rubber and cocoa sectors;

(b) To investigate further the potential to develop a ***public-private partnership*** for agricultural insurance in PNG and the respective roles of government and the private commercial insurance companies;

(c) To investigate further the technical design and rating requirements and operating systems and procedures **for named peril damage-based tropical cyclone cover in oil palm, rubber and cocoa**. Under this study it would be necessary to implement a survey of the targeted farmers to collect time series information of tropical cyclone (and allied perils – e.g. fire) damage to their oil palm plantations,

(d) To investigate further the technical design and rating requirements and operating systems and procedures for an alternative **Index-based cover for tropical cyclone only cover in oil palm, rubber and cocoa** which might be offered either as an individual farmer cover or as a macro-level emergency relief cover for government. This study would need to examine closely the issues of basis risk if individual farmer (micro-level) cover is to be provided.

(e) To investigate further technical design and rating requirements and operating systems and procedures for a **macro-level satellite rainfall index** designed to provide food security at a national level in the event of catastrophe drought.

5.11. ***Design and Implementation of Crop Insurance Pilots***. If on the basis of the detailed feasibility studies there appears to be sufficient demand for any of the above crop insurance programs in PNG, and the other outstanding technical issues listed above can be resolved, then at that stage, subject to approval by GoPNG and the private commercial insurers, decisions may be taken to move to a planning and design phase for the implementation of a pilot crop insurance program(s).

5.12. ***Creation of an Agricultural Insurance Committee***. In the short-term, the formation of an agricultural steering committee is strongly recommended to provide a forum of public and private stakeholders to meet on a regular basis in order to plan and coordinate implementation of the detailed feasibility studies. The SC could be coordinated through the existing Office of Climatic Change and Development (OCCD) because of its central role in this area of climate and agricultural risk management.

5.13. ***Creation of a Technical Support Unit (TSU)***. GoPNG should consider creating an agricultural insurance Technical Support Unit which would assist local public and private stakeholders involved in agricultural insurance on (i) data and information collection and management; (ii) insurance demand assessment; (iii) product design and rating; (iv) the design of operating systems and procedures, most notably underwriting and claims control and loss assessment procedures; (v) training for insurance companies, MFIs, farmer organizations, and farmer groups; and (vi) awareness campaigns. The technical unit would be staffed by two or three agricultural insurance specialists and report to the Steering Committee. The TSU would also act as a focal point for the provision of external technical assistance programs.

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World Bank 2011. Papua New Guinea: Country Risk Profile

Annex 1. Pacific Catastrophe Risk Assessment and Financing Initiative

Box A1. 1. Features of the Pacific Catastrophe Risk Financing Initiative (PCRFI)

Pacific Catastrophe Risk Financing Initiative
A Joint World Bank / Asian Development Bank Initiative
Co-funded by GFDRR and the Government of Japan

The Pacific Catastrophe Risk Financing Initiative aims to provide Pacific Islands countries (PICs) with disaster risk assessment tools and financial instruments to reduce their vulnerability to natural disasters. It is based on two main activities that are described below.

Pacific Disaster Risk Assessment
The Pacific Disaster Risk Assessment aims to provide the PICs with disaster risk assessment tools to help them better understand and assess their exposure to natural disasters. This component builds on close collaborations with ADB, SOPAC, GNS, Geoscience Australia, Air Worldwide, SPC and PDC.

A ***regional hazard database for major disasters*** (earthquakes, tsunamis, tropical cyclones, and storm surge) is being developed. It compiles existing hazard data into one single regional database.

A ***regional GIS exposure database of assets at risk*** is under development. It builds on high resolution satellite imagery and field visits. More than 250,000 buildings and infrastructure footprints, including ground inspection of 80,000 buildings, are expected to be digitized by December 2010. Moreover, some imagery is being made available to the Government of Samoa and the Government of Tonga as part of their reconstruction programmes following the tsunami of September 2009.

Country-specific catastrophe risk models are under development. These models use the hazard and exposure data to simulate the economic impact of natural disasters in the PICs. They provide loss maps and other risk metrics that will allow the governments and their partners to assess better their fiscal exposure to natural disasters and develop cost-effective risk mitigation programmes.

Pacific Disaster Reserve Fund
5.14. The ***Pacific Disaster Risk Fund*** aims to improve the capacity of Pacific Islands countries to access immediate liquidity in case of natural disasters while maintaining their fiscal balance. The initiative was endorsed in the Action Plan of the PALM Leader Declaration at the 5th Pacific Alliance Leaders Meeting held in Japan in May 2009. Pacific Islands countries reiterated their interest for this initiative at the 2009 World Bank/IMF Annual Meetings and during side meetings at the 2009 Forum of Economic Ministers' Meeting. The operational and financial structure of the proposed Pacific Disaster Reserve Fund is still under discussion with the Pacific Islands countries and the donor parties.

Source: World Bank / ADB Briefing Note March 11, 2010. See also http://go.worldbank.org/7BXXDUVMC0

Annex 2. List of Meteorological Weather Stations in PNG

Table A2.1. List of National Weather Service's Total Number of Stations and Stations which are Operating in 2012

REGION	PROVINCE	NO OF WEATHER STATIONS	NO. OPERATIONAL WEATHER STATIONS 2102
New Guinea Islands	Manus	43	2
	New Ireland	67	4
	East New Britain	64	1
	West New Britain	55	3
	ARB-NSP (Bougainville)	52	
Momasa	West Sepik	46	
	East Sepik	42	1
	Madang	55	
	Morobe	113	5
Highlands	Enga	21	
	Eastern Highlands	66	2(3)
	Southern Highlands	63	
	Western Highlands	60	2
	Chimbu	26	
Southern	Oro	50	2
	Milne Bay	88	5
	Central	113	2
	Gulf	34	
	Western	64	(2)
Total		1122	29(32)

Source: PNG National Weather Service, March 2012

Note: Figures in parenthesis indicate station "temporally closed"

Table A2.2. List of New Automated Weather Stations installed in 2012 by University of PNG / Digicel and financed by European Union

Province	Automated Weather Station No.	Automated Weather Station Name
National Capital District	1	Port Moresby
Central	2	Kupiano
Milne Bay	3	Alotau
Madang	4	Usino
Oro (Northern)	5	Popondetta
Oro (Northern)	6	Afore
Gulf	7	Kerema
East Sepik	8	Yangora
West Sepik	9	Vamino
Morobe	10	Bulolo
Morobe	12	Huon Peninsula
Eastern Highlands	11	Goroka
Chimbu	13	Mt Wilhelm (Mondia Pass)
Western Highlands	14	Mt Hagen (Kuli Gap)
Enga	15	Wabag
Southern Highlands	16	Lake Kutubu
Western Region	17	Kiunga
Western Region	18	Tabubil
Western Region	19	Daru
Each Automated station records the following Key Meteorological data:		
Temp – Temperature	Minimum and Maximum ten minute averages collected over the day	
Rain – Rainfall	Total amount of rainfall recorded over the day in mm	
Tot. Sol. Radiation	Total Solar Radiation over the day	
Dire - Wind Direction	Direction of the fastest gust in the day	
RH Relative Humdity	Amount of water vapour in the air, compared to the maximum amount of water vapour the air could hold at the current temperature	
Wind Speed		
Spd - Speed of Gust	The highest 10 minute average of wind speed recorded in the month period in Km/hr	
Time-Max Wind	The time and date at which the maximum wind speed was recorded	

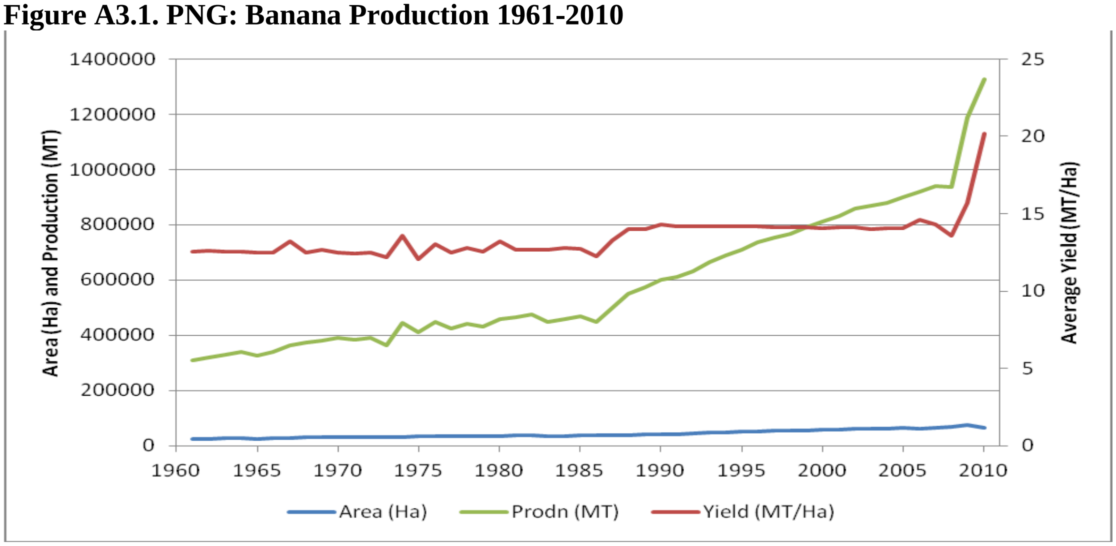
Source: http://www.pngclimate.net/pages/report.jsp

Annex 3. PNG: Crop Production Cultivated Area, Production and Yields (Food Crops and Plantation Tree Crops)

The analysis in this section shows the trends in production of the main food crops and export cash crops in PNG in terms of sown area, production and yields over the past 50 years based on FAOStat data. The FAO data are based on estimated and the accuracy cannot be verified in the absence of official food crop statistics from PNG. In the case of plantation crops, the production volumes can be verified by comparison with official production and export figures which are reported in Bourke and Harwood (2009).

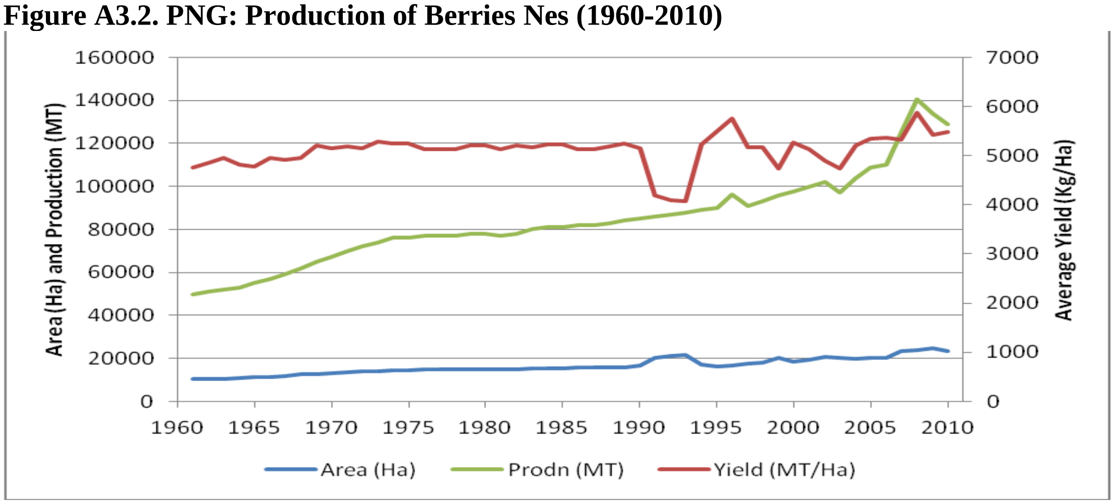
The FAO estimates of = national production figures do not show any clear correlations with rainfall patterns – for example the very severe 1997/98 droughts.

Figure A3.1. PNG: Banana Production 1961-2010



For berries the reducion in average yields between 1992 and 1994 is not known.

Figure A3.2. PNG: Production of Berries Nes (1960-2010)



For sweet potato the FAO reported reductions in average yields in 1990 and in 2009 are not known. The widely reported 1997/98 ENSO impact on sweet potato production and yields is not reflected in FAO's estimates of annual production and yields.

Figure A3.3. PNG: Sweet Potato Production (1960-2010)

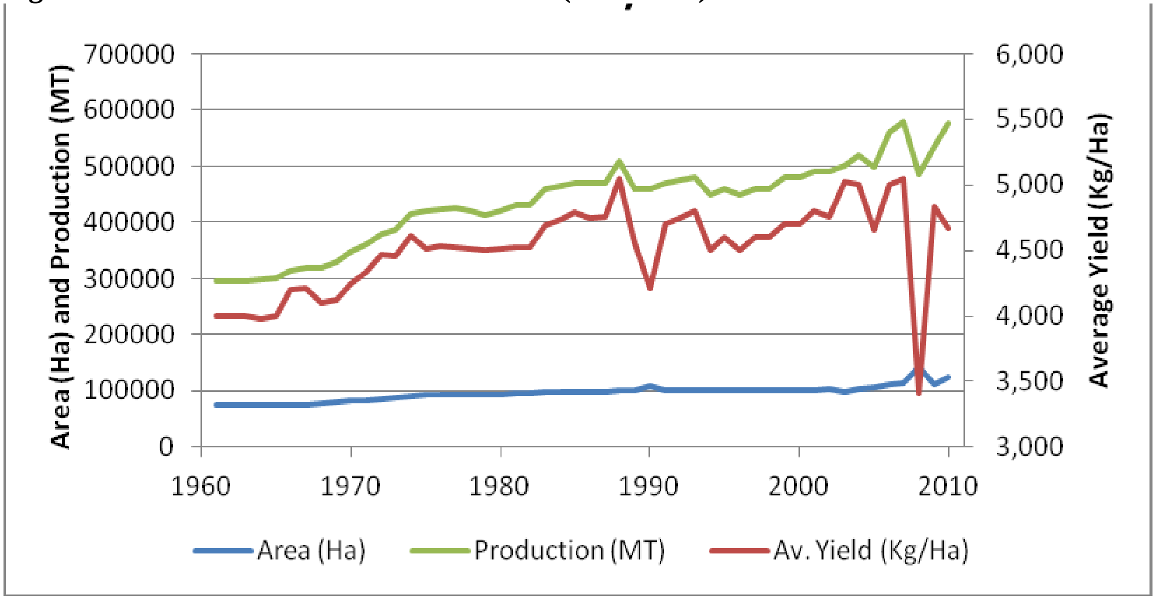
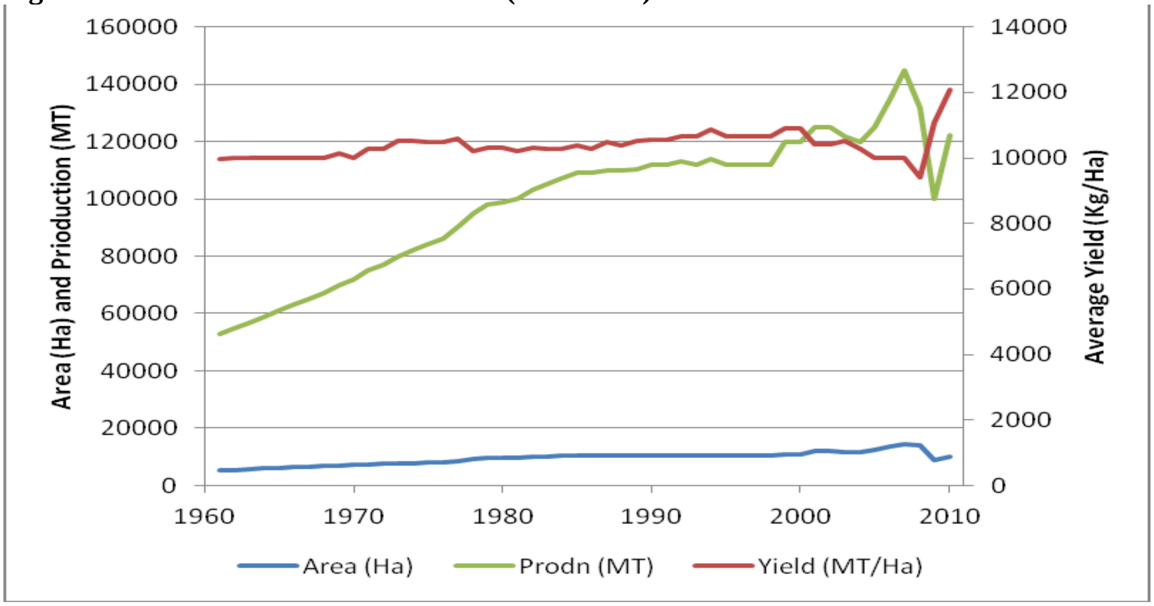


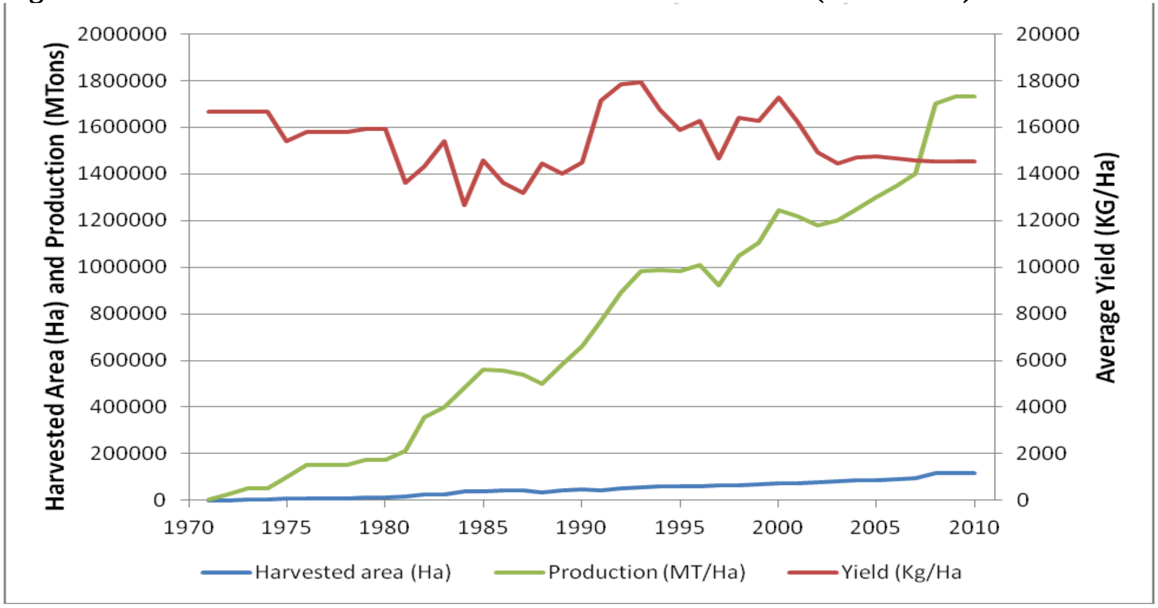
Figure A3.4. PNG: Casava Producation (1960-2010)



Cash Export Crops

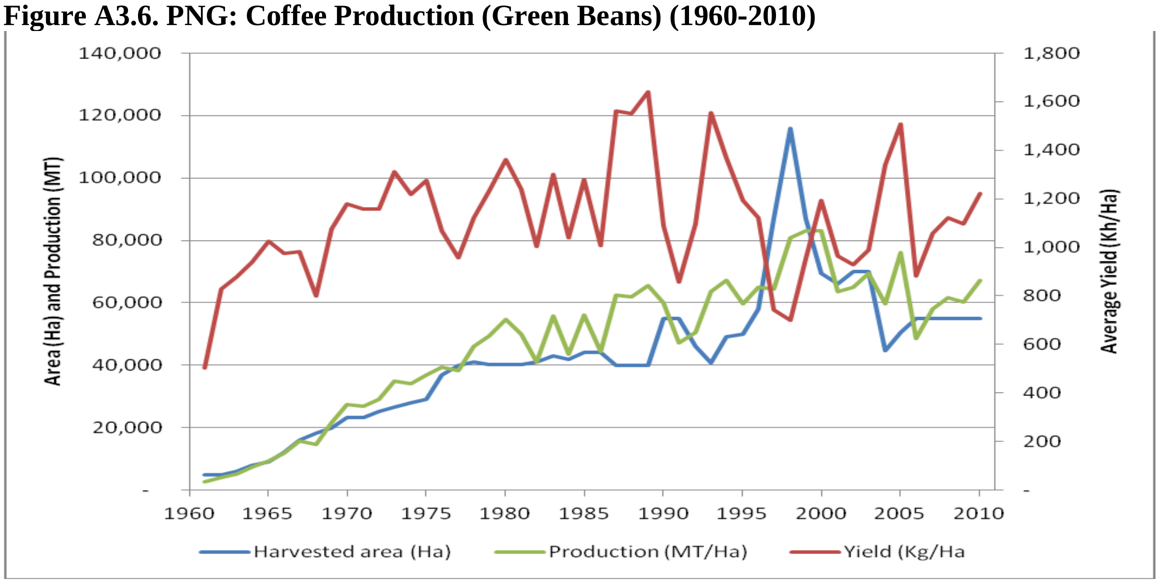
At a national level, Oil Palm production and yields show a small response to the 1997/98 El Nino drought.

Figure A3.5. PNG: Palm Oil Production and Yields 1972 to 2010 (FAOSTAT)



According to the FAO estimates coffee yields in both 1997 and 1998 were between 63% and 67% of average, but the 1997 reduced yield is due to the major increase in harvested area. The FAO figures are questionable, because according to the official statistics coffee production and yields in the 1997/98 harvest were a record – coffee responds to major drought stress by increased flowering and production in the following season.

Figure A3.6. PNG: Coffee Production (Green Beans) (1960-2010)



For cocoa the major reduction in harvested area and thus apparent increase in average yield is unexplained and is likely to be an error. In 1998 average yields of cocoa were reduced to 74% of average and this may be a response to the very severe 1997/98 El Nino droughts in PNG.

Figure A3.7. PNG: Cocoa Production (1960-2010)

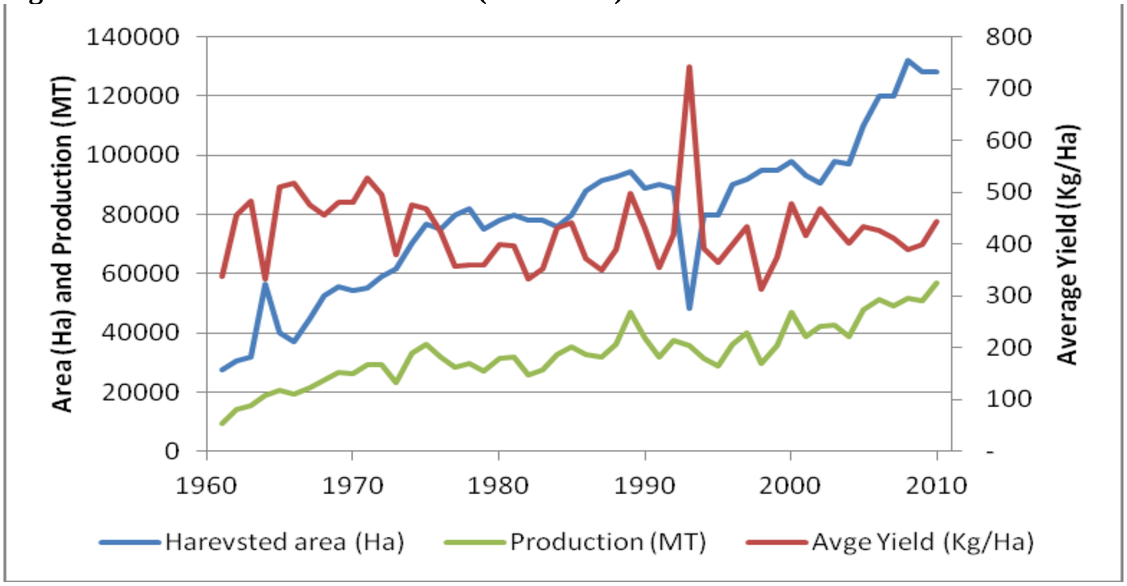


Figure A3.8. PNG: Coconut Production (1960-2010)

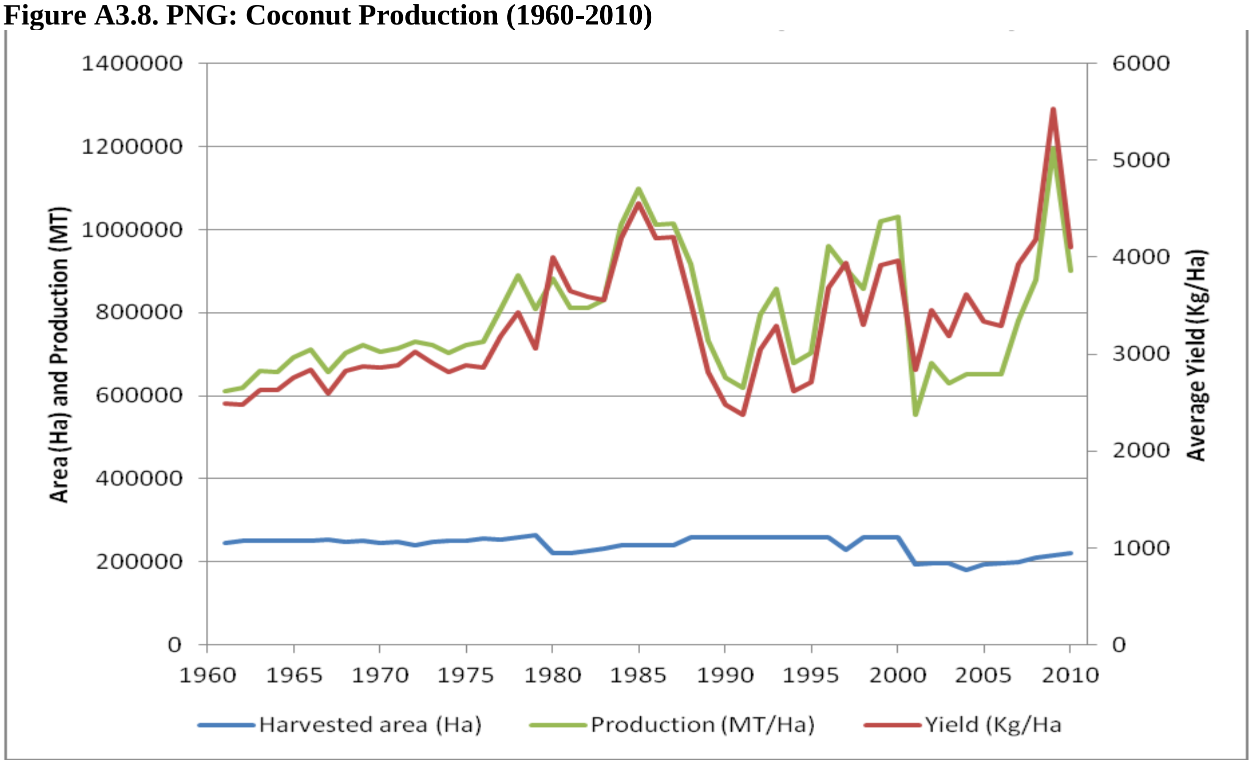
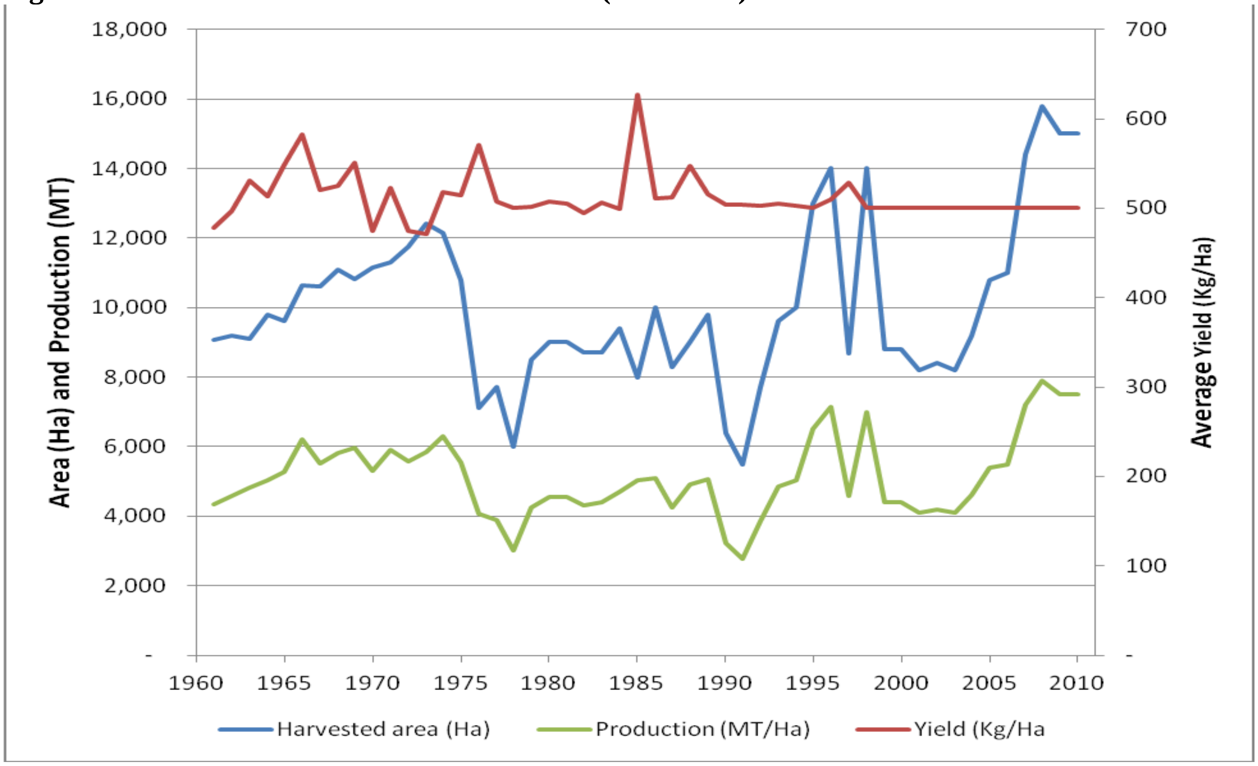


Figure A3.9. PNG: Natural Rubber Production (1960-2010)

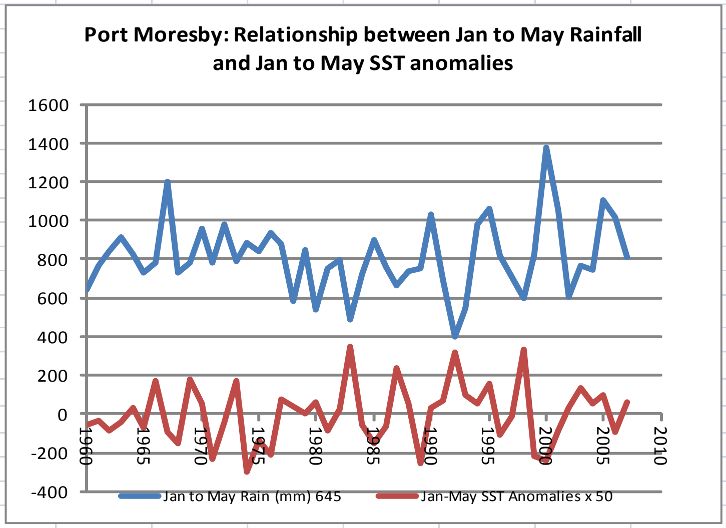


Source: FAOStat

Annex 4. PNG: Rainfall Analysis Port Moresby and Momote Weather Stations

Table A4.1. Port Moresby. Correlations Rainfall and Sea Surface Temperatures

PORT MORESBY WEATHER STATION				
	Correlations			
	-0.50745	**-0.392619**	**-0.25679**	(1960 to 2009)
	-0.55373	**-0.461711**	**-0.23295**	(1983 to 2009)
Year	Total Ann Rain (mm)	Jan to May Rain (mm)	June to Oct Rain (mm)	
1960	869	645	104	
1961	1087	765	153	
1962	1118	843	111	
1963	1491	911	466	
1964	1399	826	233	
1965	1034	732	38	
1966	1049	783	128	
1967	1449	1197	226	
1968	1128	732	176	
1969	1128.3	784	74.3	
1970	1480.8	959.6	294.6	
1971	1158.8	783.4	186.8	
1972	1015.6	980.6	15.6	
1973	1420.2	790.2	107.4	
1974	1059	886.4	114	
1975	1626.2	837.4	425.8	
1976	1537.2	939.6	294.8	
1977	1224.2	879.2	267.2	
1978	1011.6	581.8	115.8	
1979	998.8	847.2	101.4	
1980	785.2	535.8	29.4	
1981	1241	752.2	145	
1982	937.8	795	139.2	
1983	804.4	487.6	123.6	
1984	1023.8	725.8	151.2	
1985	1363	897.6	225.2	
1986	937.4	756.6	134.4	
1987	824.2	663	27.4	
1988	1203.2	740	143.4	
1989	1326	753.4	306.8	
1990	1433	1029.6	322.8	
1991	892.8	692.4	86.8	
1992	648	398.6	79.6	
1993	677.6	543.8	44	
1994	1087.2	982.2	85.8	
1995	1394.6	1057.4	189.4	
1996	1380.4	822	221	
1997	827.8	708.4	30.6	
1998	1096.6	598.2	135	
1999	1289.2	825.8	155	
2000	1554.2	1377.2	77	
2001	1365.8	1051.8	137	
2002	713	603.4	50	
2003	1164.2	765.6	101	
2004	1417	746.6	532.6	
2005	1351	1103.4	46.4	
2006	1173	1018	97.2	
2007	1519.8	810	237.4	
2008	978.4	566	174.8	
2009	1519	1150.2	183.6	
2010	1126	674.6	197.6	



Source: Author's analysis

Table A4.2. Mamote Correlations Rainfall and Sea Surface Temperature

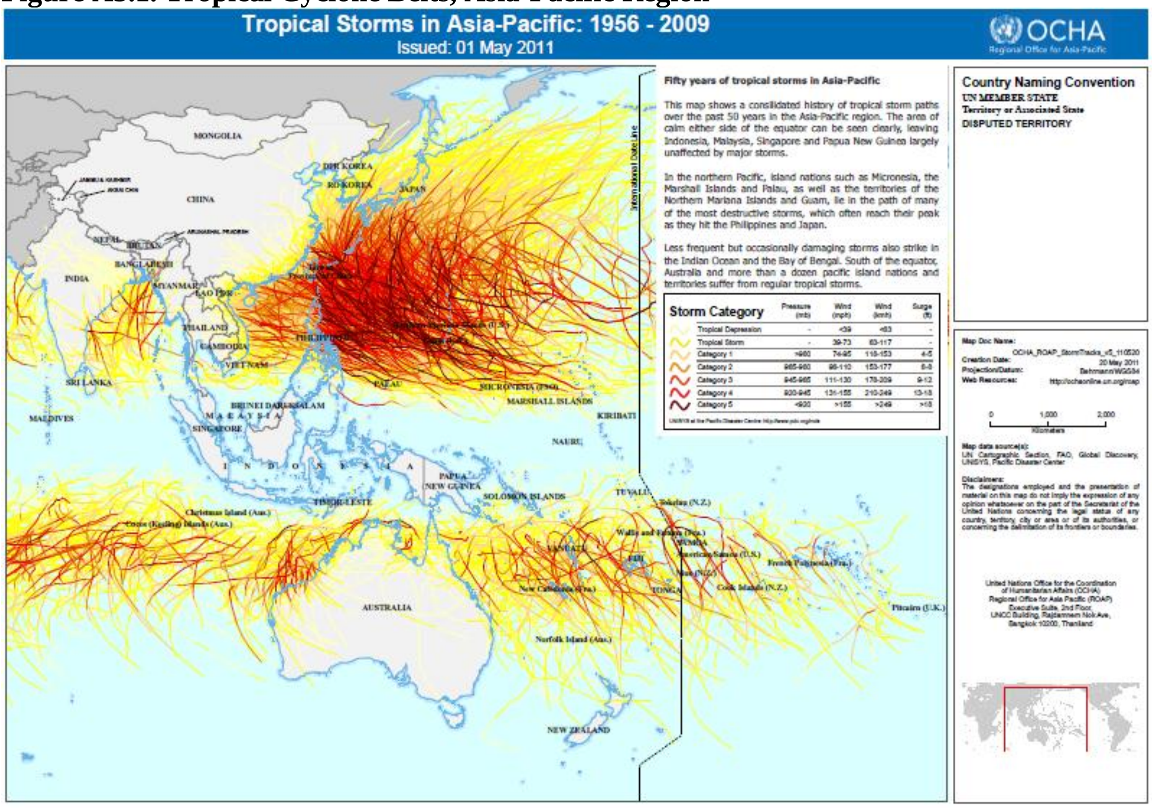
	MOMOTE WEATHER STATION			
	Correlations			
	-0.005139	**-0.04752**	**-0.078839**	
Year	Total Ann Rain	Jan to May Rain	June to Oct Rain	
1973	3682.4	1906.8	1322	
1974	3251.8	1406	1057	
1975	2840.8	1404.8	1040	
1976	2872	1222.6	1046.4	
1977	4124	1644.6	1777.4	
1978	3197.2	1239	1350.8	
1979	3264.6	1534.2	1270.4	
1980	4249.8	1270	2370.6	
1981	3310.6	1134	1458.4	
1982	2649.8	1448.8	635.6	
1983	3849.2	1198.2	2189.4	
1984	2896.6	1172	1156.8	
1985	3318.6	1262.6	1415.2	
1986	3362.4	1490.8	1094.8	
1987	2873.2	1146.6	1248.8	
1988	3283	1294	1343.2	
1989	3061.4	1280.4	1050.4	
1990	3720.6	1494.6	1791.2	
1991	3923.4	1421.6	2079	
1992	2688.2	1125.8	1200.2	
1993	2889.6	1031.6	1272	
1994	3433.4	1219.4	1685.6	
1995	3188.4	1246.2	1520.2	
1996	3003.8	1386.6	1262.2	
1997	2529	1218.4	598.4	
1998	3188.6	1173.4	1418.2	
1999	3001.2	1132.6	1312.2	
2000	3081.6	1143.2	1472	
2001	4069.8	1903.2	1736.6	
2002	2783.6	1130.4	1019.8	
2003	3751.8	1433.2	1682.4	
2004	3738.2	1468.8	1741.4	
2005	3926.4	1750	1608.4	
2006	3335.4	1298.6	1616	
2007	3807.4	1415.4	1798.8	
2008	3507	1417.2	1374.4	
2009	3783.6	1676	1640.6	
2010	2529.2	1344.2	930.2	

Source: Author's analysis

Annex 5. PNG: Tropical Cyclone Analysis

Papua New Guinea is at the north western tip of the South Pacific Ocean Tropical Cyclone (SPAC) belt. Figure A5.1.

Figure A5.1. Tropical Cyclone Belts, Asia-Pacific Region



There is evidence that the frequency of Tropical Cyclones (TCs) in the SPAC Region is influenced by the El Niño Southern Oscillation and specifically that there is a considerably higher incidence of TCs in La Nina Years (Figures A5.2. to A5.5.).

Figure A5.2. Average Number Tropical Cyclones All Years

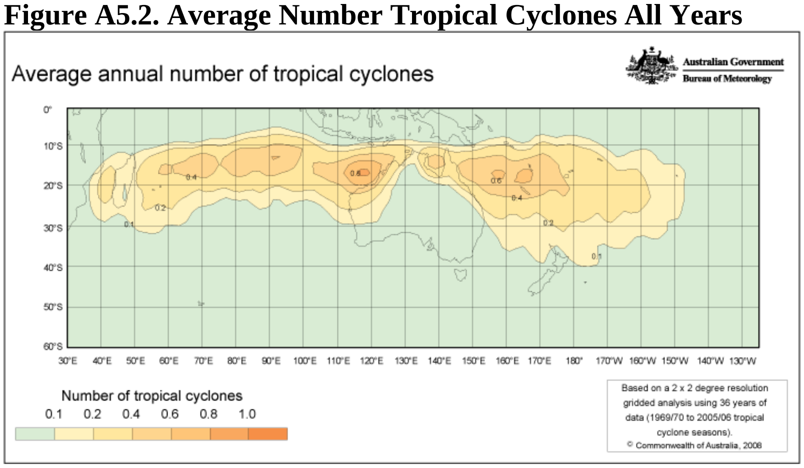


Figure A5.3. Average Number Tropical Cyclones, Neutral Years

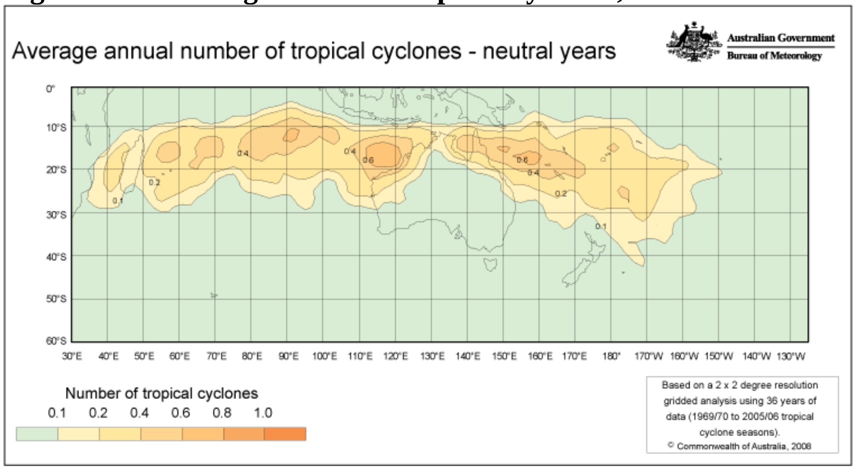


Figure A5.4. Average Number Tropical Cyclones La Niña Years

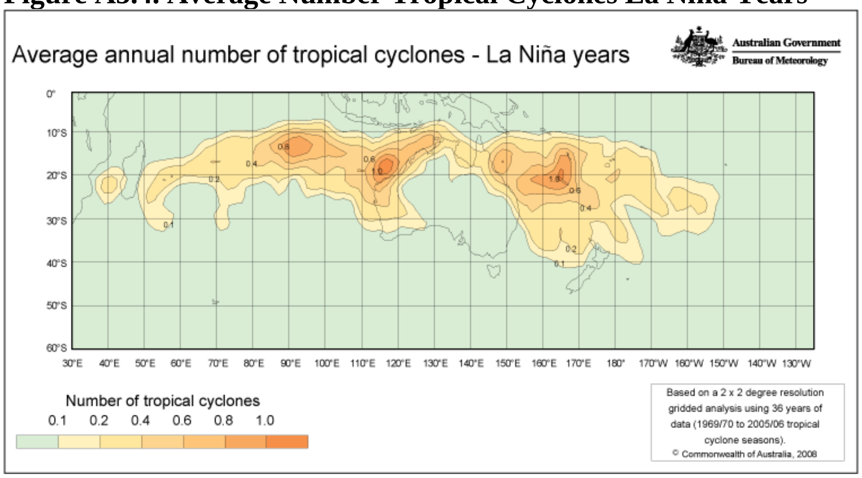
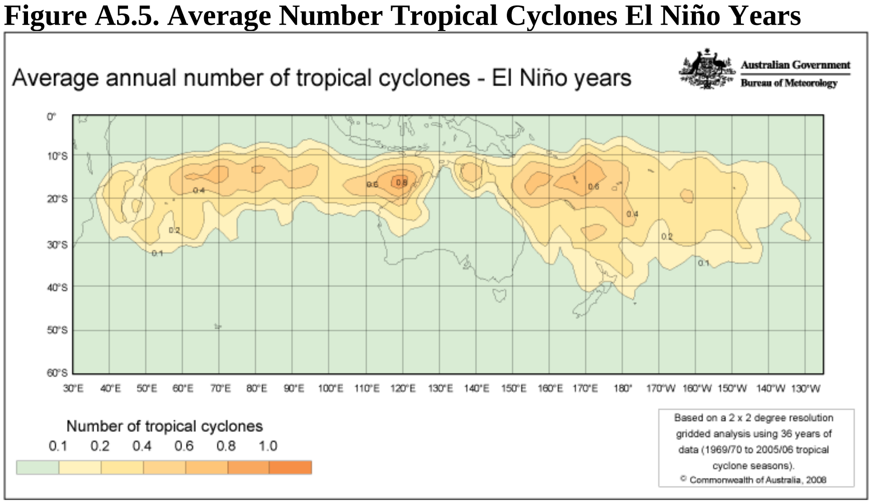


Figure A5.5. Average Number Tropical Cyclones El Niño Years



Source: Australian Bureau of Meteorology

Tropical Cyclone exposure to Papua New Guinea from South Pacific Tropical Cyclones

http://australiasevereweather.com/cyclones/index.html

The data presented in this report have been downloaded from the Australia Severe Weather Website for the South Pacific Ocean Tropical Cyclone (SPAC) belt for the 35 year period 1976/77 to 2010/11. (http://australiasevereweather.com/cyclones/index.html)

The data are based on the tropical cyclones reported by the Joint Typhoon Warning Centre (JTWC) which is known to exclude a number of TC events.

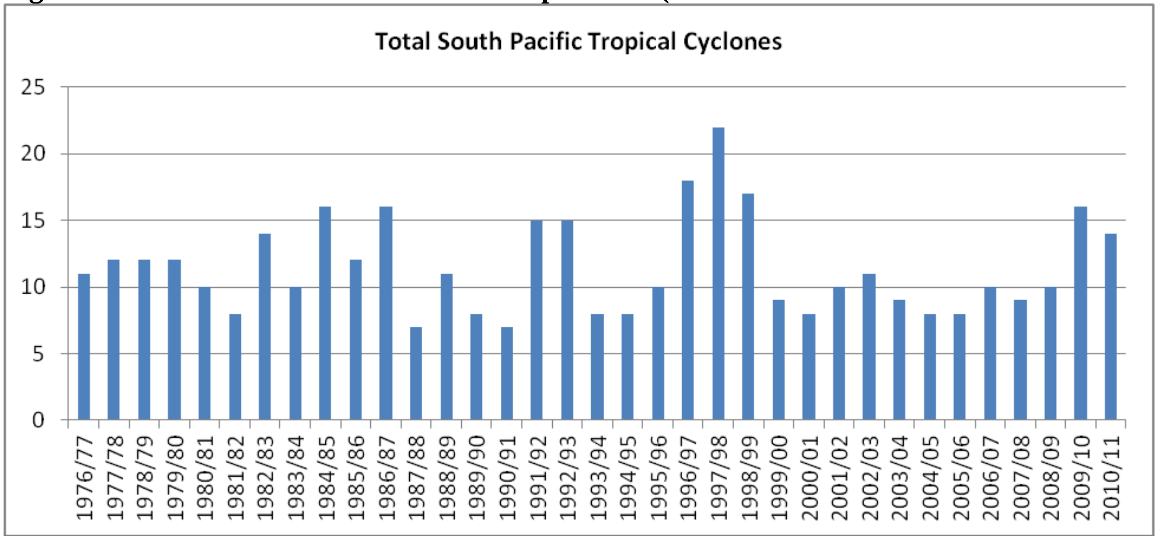
The classification used in this report of SPAC TCs by wind speed is shown in Table A5.2. This classification follows the Saffir-Simpson scale in identifying Tropical Depressions, (windspeeds less 35 Knots), Tropical storms (35-63 Knots) and then Hurricanes in excess 83 knots according to 5 scales of intensity.

Table 5A.1. Saffir–Simpson Hurricane Scale

Tropical Cyclone	**Category**	**Wind speed**	**Wind speed**	**Wind speed**	**Storm surge**	
		mph	**Km/hr**	**Knots**	**ft**	**Metres**
Hurricane	Five	≥ 157	≥ 252	≥ 137	> 18	> 5.5
Hurricane	Four	130–156	209–251	113–136	13–18	4.0–5.5
Hurricane	Three	111–129	178–208	96–112	9–12	2.7–3.7
Hurricane	Two	96–110	154–177	83–95	6–8	1.8–2.4
Hurricane	One	74–95	118–153	64–82	4–5	1.2–1.5
Tropical Storm	TS	39–73	63–117	35–63	0-3	0–0.9
Tropical Depression	TD	0–38	0–62	0–34	0	0

Over the 35 year period 1976/77 to 2010/11 an average of about 12 tropical cyclones per year have been experienced in the SPAC Region with range from a low of 7 events in 1987/88 and a peak of 22 events in 1997/98 (Figure A5.6.). There are no statistically significant trends in the number of TCs over this period.

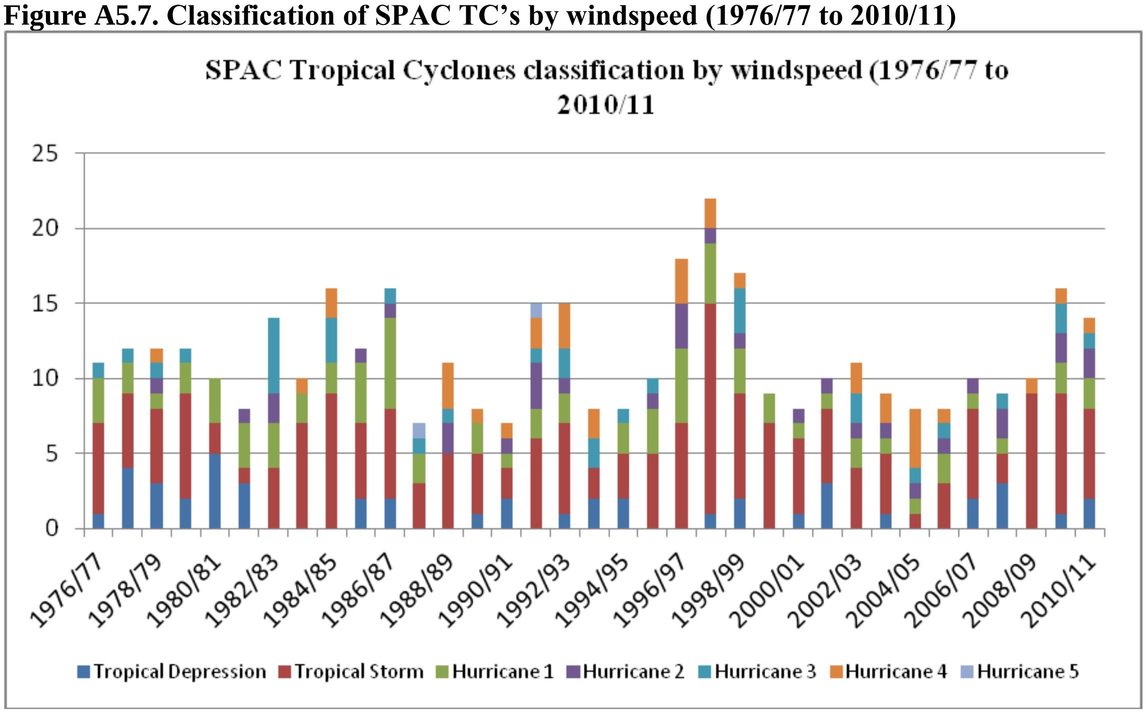
Figure A5.6. Number of South Pacific TCs per Year (1976/77 to 2010/11



Source: Authors' analysis

The classification of these TC's by windspeed is shown in Figure A5.7. It is predicted that over the 21st century the frequency of SPAC TCs may decline slightly, but that the intensity of Hurricane 1 and above events may increase (Australian Bureau of Meteorology and CSIRO, 2011.

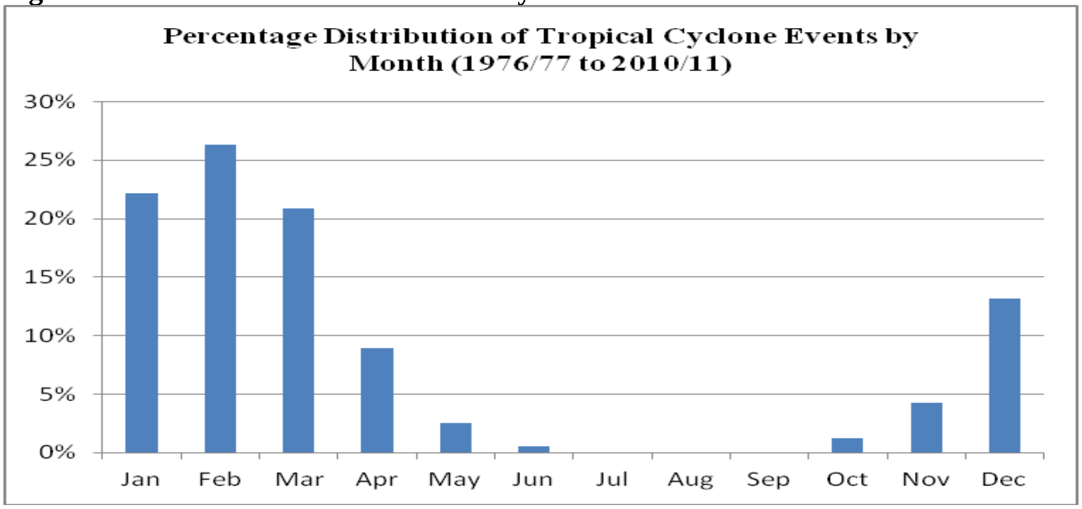
Figure A5.7. Classification of SPAC TC's by windspeed (1976/77 to 2010/11)



Source: Authors' analysis

The Tropical Cyclone season in the SPAC Region runs from November to May with nearly 70% of all TC events occurring between January and March (Figure A5.8).

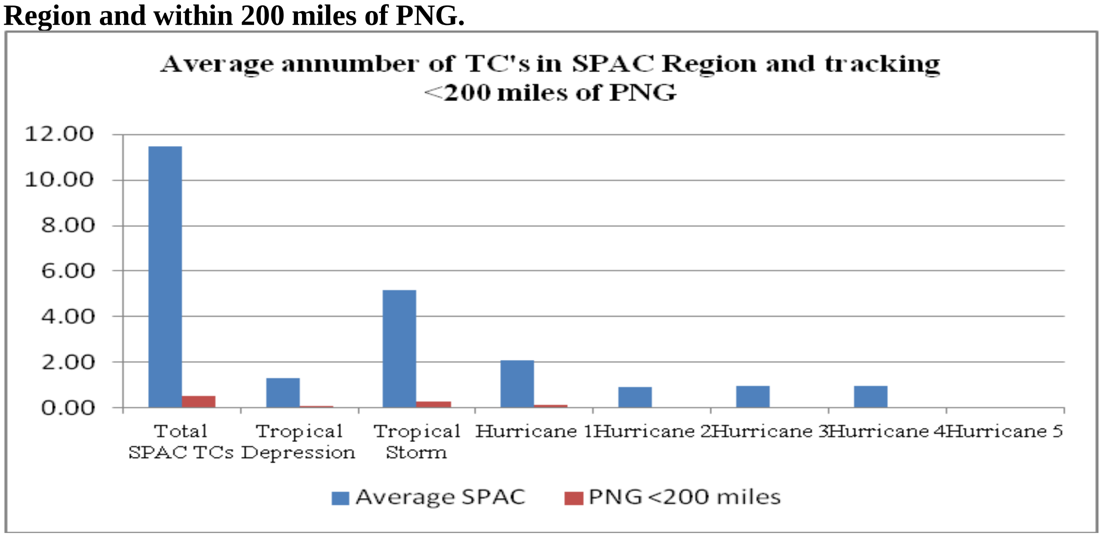
Figure A5.8. Distribution of SPAC TCs by month



Tropical Cyclones passing within 200 miles of PNG

While an average of nearly 12 Tropical cyclones are experienced each year in the SPAC region, PNG lies to the north west of this TC belt and only experiences an average of only 0.54 TC's every year (or 1 TC every two years) which track within 200 miles of anywhere in the country. (Figure A5.9).

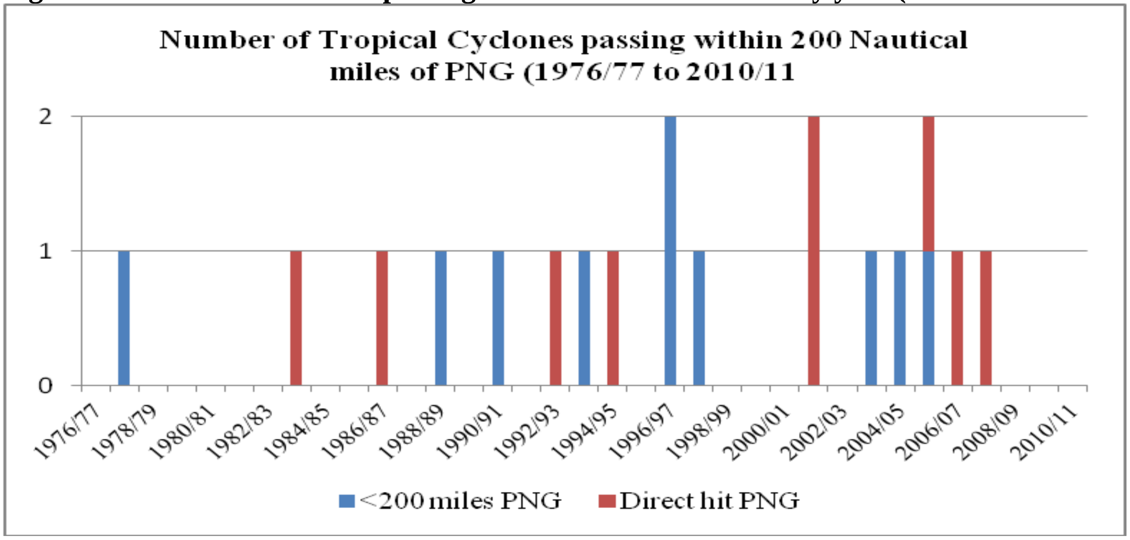
Figure A5.9. Comparison of Average Number of TCs by category and by year in SPAC Region and within 200 miles of PNG.



Source: Authors' analysis

Over the past 35 years a total of 19 TCs have affected PNG (defined by the Author as those TC's which have tracked within 200 miles of any part of PNG) including the 700 or so Islands which make up the country (Figure A5.9). Nine TCs (50% of total) have directly hit some part of PNG, while the other 50% of the TCs have been within 200 miles of PNG. A full list of the 19 TCs that have affected PNG over this period is attached as Table A5.2.

Figure A5.10. Number of TCs passing within 200 miles of PNG by year (1976/77 to 2010/11)



Source: Author' analysis

The TC exposure is mainly confined to the south eastern provinces of PNG including Milne Bay, Oro Central Region and Port Moresby, although some TCs originating in the Coral Sea or Gulf of Papua have also affected the coastal regions of Gulf and Western Provinces. Also some TCs that develop east of PNG in the Pacific Ocean have affected Bougainville Island in the past 35 years. Between 1976/77 and 2010/11 there were TCs recorded within 200 miles of New Britain, New Ireland and the northern and highland provinces of PNG.

The most serious damage to agriculture was incurred under **TC Guba** (12 to 19 November 2007). Guba originated in the Solomon Sea and tracked south west through Oro and then Central Province as a Tropical Storm TS causing extensive damage to the oil palm crop. Guba subsequently strengthened to a Category 1 Hurricane in the Coral Sea.

Cyclone Justin hovered near Sudest and Rossel Islands in the Misima area of the Samarai – Murua district for 13 days from 6-20 March 1997. Windspeeds of 140 to 160 km per hour at its centre and of 80 km per hour on the outer permiter caused damage estimated at PGK 1.3 million (approximately US$ 0.9 million). Damage was recorded as far west as Rabaraba on mainland Milne Bay. In all an estimated 22,000 people in all four districts of the province were affected by cyclone Justin[27].

[27] Allen, J., 2001. The El Niño Drought: An Overview of the Milne Bay experience. In Bourke, R.M., Allen, M.G. and Salisbury, J.G., ed. 2001. Food Security for Papua New Guinea. Proceedings of the Papua New Guinea Food and Nutrition Conference, PNG University of Technology, Lae, 26-30 June 2000

Table 5A.2. Summary of TC events which have tracked within 200 miles of PNG over the past 35 years (1976/77 to 2010/11)

Year				Maximum Speed when <200 miles PNG									
Year	Cyclone Name	Date Range (UTC)	Max wind speed (Knots)	TD	TS	H1	H2	H3	H4	H5	<200 miles	Direct hit PNG	Comment
				Tropical Depression	Tropical Storm	Hurricane 1	Hurricane 2	Hurricane 3	Hurricane 4	Hurricane 5			
2007-08	GUBA	12 Nov 2007 - 19 Nov 2007	75			1						1	Guba was tropical storm or less when passed through NE-SW PNG Mainland through central & Northern provinces
2006-07	PIERRE	16 May 2007 - 21 May 2007	40		1							1	Pierre Track E-W Hit PNG Mainland: Milne Province and Central and Northen Provinces TD speeds 15 to 21 May
2005-06	KATE	22 Feb 2006 - 24 Feb 2006	50		1						1		Small TD south of Port Mortesby that never got to be a TS in PNG
2005-06	MONICA	16 Apr 2006 - 26 Apr 2006	135			1						1	16 April TS track NE-SW through tip of Milne Bay Province rising to Huricane 1 on 17 April as exited Milne Bay into Coral Sea
2004-05	INGRID	05 Mar 2005 - 19 Mar 2005	120		1						1		4-6 March tracked W-East approx 200 km or > south of PNG P Moresby- possible edge effect
2003-04	FRITZ	08 Feb 2004 - 12 Feb 2004	45		1						1		TD started south Bouganville 8 Feb and track SW. Possible edge effects in Louisade Arcipelligo
2001-02	200203	15 Nov 2001 - 24 Nov 2001		1								1	Track E-W off Port Moresby 16 Nov and hit Western Province on 17/18 Nov - speeds 20-25 knots TD speed.
2001-02	UPIA	25 May 2002 - 29 May 2002	50		1							1	NE-SW track through BOUGANVILLE at speeds 25 Knots . Max = 35 knots of just a TS.
1997-98	NATHAN	21 Mar 1998 - 31 Mar 1998	50		1						1		Started 19 March south P Moresby at a TD and trcked south towards Cairns vbefore veering into Coral see... Max wind =65 knots on 23 March
1996-97	GILLIAN	08 Feb 1997 - 12 Feb 1997	45		1						1		Start as TD in Solomon sea well south of Bouganville and track south west 9 feb < 200 miles Louisidia Archipelligo, Milne Bay Province
1996-97	JULIAN	03 Mar 1997 - 29 Mar 1997	90				1				1		From 14 to 20 March, Justin hovered off the south east of Sudest and Rossel Isalnds and acsue damage as far west as Milne Bay province affecting 22,00 people and causing damage valued at PKG 1.3 million
1994-95	AGNES	15 Apr 1995 - 23 Apr 1995	110			1						1	Start 15 April as TD off Western Province coast and track SW in Coral sea as Cat 3 H on 19 April before doubling back towards Port Moresby and coast of Central & Gulf as aTS
1993-94	THEODORE	22 Feb 1994 - 28 Feb 1994	115				1				1		TD started SW of Bouganville on 22 feb and track due south past Lousiade Archipelligo as a Cat 1 and Cat 2 H on 24/25 Feb
1992-93	ADEL	11 May 1993 - 16 May 1993	45		1							1	TS on 13 May track through Bouganville - SW to Milne Bay / Central, and track west past PM to hit Western Province on 16 May Max speed 45 knots TS
1990-91	LISA	07 May 1991 - 12 May 1991	80			1					1		Start 7 May south BOUGANVILLE as a TS and track south into Coral sea Possible edge effect Louisiade Islands, Milne Bay
1988-89	AIVU	29 Mar 1989 - 05 Apr 1989	120			1					1		Possible minor edge effects H1 to Lousiana Archipelligo, Milne Bay as tracked south
1986-87	KAY	06 Apr 1987 - 17 Apr 1987	65	1								1	TD track E_W north Cairns hitting tip of Western Province on 7 April as a TD
1983-84	JIM	06 Mar 1984 - 12 Mar 1984	45	1								1	Start in Mine Bay and track WSW as TD / light TS.
1977-78	TOM	06 Nov 1977 - 12 Nov 1977	50		1						1		6 nov start as Td east of Bouganville and track south. V minor edge effects?
Total 1976/77 to 2010/11				**3**	**9**	**5**	**2**	**0**	**0**	**0**	**10**	**9**	

Annex 6. PNG: List of Active Volcanoes

Table A6.1. List of Active Volcanoes

Province	Name of Volcano	Province	Name of Volcano	Province	Name of Volcano
Bougainville	Bagana	**West New Britain**	Langila	**Central**	Koranga
	Bakanovi		Dakataua		Madilogo
	Tore		Bola		
	Balbi		Garua	**Madang**	Manam
	Billy Mitchell		Garbuna		Boisa
	Takuan		Lolo		Karkar
	Loloru		Buru		Yomba
			Pago		Long Island
New Ireland	Lihir		Walo		Unnamed
	Ambitle		Karai (Sulu Range)		
	Tanga		Narage	**East Sepik**	Kairiru
			Mundua		Kadovar
Manus Province	Tutuman		Garove		Bluop Blup
	Baluan		Unnamed		Bam
	Unnamed		Unnamed		
			Pangalu Geothermal Range	**South. Highlands**	Bosavi
East New Britain	Rabaul		Willaumez Peninsula		Doma Peaks
	Hargy				Giluwe
	Bamus	**Milne Bay**	Goodenough		
	Ulawun		Iamelele	**Oro**	Lamington
	Lolobau		Lamonai		Hydrographers Range
	Tavui		Oiau		Managlaswe Plateau
			Donbu		Musa River
Morobe	Unboi				Victory
	Sakar	**Eastern Highlands**	Crater Mountain		Trafalgar
	Ritter Island		Yelia		Sessagara
	Koranga				Waiowa

Source: http://www.volcanolive.com

Annex 7. PNG: Summary of Losses due to Natural Disasters 2000 to 2012

Table A7.1. Natural Disasters in PNG 1901 to 2000

Period	Type of Disaster	No Events	No. People Killed	No. People Injured	No. People Homeless	No. Affected People	Total Affected	Value of Damage (US$ 000)
1921-1930	Wave/surge	1	11					
131-1940	Volcano	1	506			7,500	7,500	
1951-1960	Earthquake	1	3,000					
	Volcano	3	3,000			5,200	5,200	
1961-1970	Earthquake	1	15					1,750
1971-1980	Earthquake	3						
	Flood	1						
	Slide	3	113					
	Volcano	1						
	Wind storm	1						
1981-1990	Drought	1				40,000	40,000	
	Earthquake	11	454		4,000	13,000	17,000	31,625
	Flood	2	56			2,000	2,000	11,900
	Slide	1	76			600	600	
	Volcano	1				25,000	25,000	
1991-2000	Drought	2	98			1,206,000	1,206,000	
	Earthquake	2	54	200	15,000	10,000	25,200	
	Epidemic	1	114					
	Flood	3	2		78,000	104,000	182,000	2,500
	Slide	2	238	8	5,000		5,008	
	Volcano	4	9	31	46,000	107,800	153,831	400,000
	Wave/surge	1	2,182	668		9,199	9,867	
	Wild Fire	1				8,000	8,000	
	Wind storm	2	47	40	22,500	25,000	47,540	1,500
Grand Total		**50**	**9,975**	**947**	**170,500**	**1,563,299**	**1,734,746**	**454,275**

Source:www.adrc.asia/publications/databook/ORG/databook/PNG.pdf

Table A7.2. Top 10 Natural Disasters in PNG (1951-2012) sorted by number of people killed

Disaster	Date	No Killed	Author's Comment
Volcano	15/01/1951	3,000	
Earthquake (seismic activity)	17/07/1998	2,182	
Volcano	29/05/1937	506	
Mass movement wet	24/02/1991	200	
Storm	12/11/2007	172	Tropical Cyclone Guba
Epidemic	01/01/2002	122	
Epidemic	04/02/1998	114	
Mass movement wet	21/03/1971	100	
Epidemic	22/08/2009	83	
Mass movement dry	06/09/1988	76	

sorted by numbers of total affected people:

Disaster	Date	No Total Affected	Author's Comment
Drought	Sep-97	500,000	Estimates as high as 1.2 million
Storm	12/11/2007	162,140	Tropical Cyclone Guba
Volcano	19/09/1994	152,002	Mt Rabaul, West New Britain
Flood	Mar-92	90,000	
Flood	08/12/2008	75,300	
Flood	12/06/1993	54,000	
Storm	14/05/1993	40,040	Tropical Cyclone Adel
Drought	Oct-80	40,000	
Flood	23/04/1999	38,000	
Volcano	15/10/1983	25,000	

sorted by economic damage costs:

Disaster	Date	Damage (000 US$)	Author's Comment
Volcano	19/09/1994	110,000	Mt Rabaul Willis estimate at US$ 531 million
Flood	23/04/1999	43,228	
Flood	Sep-83	11,900	
Earthquake (seismic activity)	13/10/1993	5,000	
Earthquake (seismic activity)	09/02/1987	2,625	
Flood	12/06/1993	2,500	
Earthquake (seismic activity)	31/10/1970	1,750	
Storm	14/05/1993	1,500	Tropical Cyclone Adel
Earthquake (seismic activity)	11/05/1985	1,000	
Earthquake (seismic activity)	24/06/1986	500	

Source: "EM-DAT: The OFDA/CRED International Disaster Database

www.em-dat.net - Université Catholique de Louvain - Brussels - Belgium"

Annex 8. PNG: Summary of Flood Events 1992-2012

Register #	Location	Began	Ended	Duration in Days	Dead Persons	Displaced Persons	Damage (USD)	Main cause	Severity *	Affected sq km	Comments
3225	Oro Province - Sakarina, Afore, Mamba, Kamusi, Girua. Tufi, Wanigela, Sinei, Berobona, Ako and Gobe areas. Sohe, Ijivitari, Higaturu, Popondetta. Gona, Bakubari, Katuna and Ambasi. Numba, Kokoda. Kewansasap. Milne Bay Province - Rabaraba district.	12/11/2007	26/11/2007	15	170	13,000	183,000,000	Tropical cyclone	1	12,652	Several days of heavy rain associated with tropical cyclone Guba. Large areas of Oro province flooded and many villages underwater. At least 13,000 homeless. 75 dead. 51 missing. 145,000 people affected. More than 1,000 homes destroyed. Damage to roads, crops and bridges. 95% roads in Oro destroyed.Damage estimate in Oro province for rebuilding roads, bridges and wharves - $183 million U.S. dollars
3163	Huon Peninsula area - Morobe Province - Finschhafen, Bukawa village. Lae. Boana Buang	10/08/2007	21/08/2007	12	2	5,000	0	Heavy rain	1	2,710	Two weeks continuous rain causes floods and landslides. Three major rivers break their banks. 12,000 affected by flooding. Bridges destroyed.
2854	Southern Highlands Province: Upper Mendi region - Kuma	27/04/2006	30/04/2006	4	1	300	0	see notes	1	4,699	Rush of water down from the volcano Mt. Giluwe following an explosion up the mountain. Flooding down river and landslides.
2846	East Sepik Province: Ambunti-Drekikier electorate - Hauna, Gawanga 2, Wam/Urat	12/04/2006	18/04/2006	7	0	400	0	Heavy rain	1	41,564	Damage to vanilla fields, rice, cocoa and fish ponds. Hundreds left homeless. Flooding and landslides.
2812	Western Highlands Province: Dei district villiages - Yan, Muga, Kema, Komund, Meka, Kram	18/02/2006	24/02/2006	7	6	5,000	0	Heavy rain	1	7,507	5 villiages devastated. 500 stricken with malaria and typhoid.
2795	Provinces: Central, Gulf, National Capital (Port Moresby)	03/02/2006	19/02/2006	17	1	12,000	0	Heavy rain	2	34,452	Water up to 2 meters. 12,000 displaced and food gardens of 800 others destroyed. Flooding is seasonal but a Biotou village elder said it was the worst he had seen since the war in 1942-43.
2459	Madang province - Walium district, Ramu valley. Saussi mission. Chuave area. Walium-Saussia region	20/03/2004	31/03/2004	12	2	4,000		Heavy rain	1	3,315	Ten days of rain cause floods that "swept away bridges, roads and hundreds of homes"
2449	Western Highlands - Waghi valley. Anglimp, Aviamp, Kudjip, Kundiawa, Goroka.	05/03/2004	09/03/2004	5	0	10,000		Heavy rain	1	2,011	Continuous heavy rains for two weeks cause several rivers to flood on March 5."..rising floodwaters badly damaged a bridge near Kudjip, washing away parts of the Highlands Highway"
2378	Morobe Province - Labuta LLG: Mundala, Bukawa, Waganlugu and Ulugidu. Salamaua LLG and Burum-Kuat LLG.	06/11/2003	10/11/2003	5	2	5,000		Heavy rain	1	952	2,600 people in Bukawa area lost their food gardens to flooding. News report on November 7 says the flooding was 'recent'
2220	Ambunti, Angoram, Pagwi.	14/04/2003	04/05/2003	21	0	0		Heavy rain	1	24,063	Heavy rain in the Highlands caused the Sepik River to break its banks and flood villages along the river. "The peak was approximately the same as 1997 but well below the 1973 flood level."
1349	East Sepik Province - Ambunti, Angoram districts	27/04/1998	01/05/1998	5		30,000		Heavy rain	1	53,963	Heavy rains follow El Nino-related drought
824	Southeastern Papua New Guinea	16/01/1994	20/01/1994	5	9	0		Tropical cyclone	1	65,498	
818	Central highlands, Chimbu Province	29/12/1993	30/12/1993	2	14	3,500		Heavy rain	1	9,588	"a fierce storm hit villages in the western highlands and chimbu province of papua new guinea (png) early today, leaving at least 14 people dead and more missing. " CAUSE:Heavy rains
645	Provinces - East Sepik, West Sepik	03/05/1992	06/05/1992	4	0	10,000	12,000,000	Heavy rain	2	71,645	Called Papua New Guinea's worst ever natural disaster.

Source: Dartmouth Flood Observatory, http://floodobservatory.colorado.edu/

Annex 9. Named Peril Windstorm (plus allied perils) Growing Tree Crop Policy Wording (Malaysia)

Malaysia, Specimen Wording for Named peril Fire, Windstorm and Flood Cover in Oil Palm, Rubber and Cocoa

INSURANCE OF GROWING TREES

WHEREAS the Insured by a proposal and declaration which shall be the basis of this contract and is deemed to be incorporated herein has applied to_______________ (hereinafter called the "Company") for the insurance hereinafter contained and in consideration of the payment by the Insured to the Company of the First Premium.

THE COMPANY AGREES (subject to the Terms and Conditions contained herein or endorsed hereon) that if after payment of the premium the Property Insured described in the Schedule or any part of such Property Insured be destroyed or damaged by fire or lightning whether accompanied by fire or not or any of the perils specified in the Schedule at any time during the Period of Insurance stated in the Schedule or during any further period for which the Company may accept payment for the renewal of this Policy, the Company will pay or make good to the Insured the value of the Property Insured at the time of the happening of its terms and conditions of this Policy. PROVIDED THAT the liability of the Company shall in no case exceed in respect of each item the sum stated in the Schedule to be insured thereon or in the whole the Total Sum Insured hereby or such other sum as may be substituted therefor by endorsement hereon or attached hereto signed by or on behalf of the Company.

1. CONDITIONS PRECEDENT TO LIABILITY

The due observance and fulfillment of the terms, conditions and endorsements of this Policy insofar as they relate to anything to be done or complied with by the Insured shall be conditions precedent to any liability of the Company to make any payment under this Policy.

2. MISDESCRIPTION

If there be any material misdescription of any property insured or any misrepresentation as to any fact material to be known for estimating the risk, or any omission to state such facts, the Company shall not be liable upon this Policy so far as it relates to property affected by any such misdescription, misrepresentation or omission.

3. PREMIUM PAYMENT

No payment in respect of any premium shall be deemed to be payment to the Company unless a printed form of receipt for the same signed by an Official or duly appointed Agent of the Company shall have been given to the Insured.

4. CO-INSURANCE

The Insured shall give notice to the Company of any insurance or insurances already effected, or which may subsequently be effected, covering any of the property hereby insured, and unless such notice be given before the occurrence of any loss or damage, all benefits under this Policy shall be forfeited.

5. SUM INSURED

The basis of determination of sum insured for this insurance shall be as set out in the Schedule. For this purpose mature trees shall be trees which are more than 3 years since planting (5 years in case of Rubber trees) and not more than 25 years since planting (30 years in case of Cocoa and Rubber trees).

Trees which are younger shall be regarded as immature. Trees which are older shall not be insured under this Policy.

6. INSURED TREES

The insurance under this policy shall apply only to the trees as specified in the Schedule grown on the estates of the Insured and all other trees are excluded from this insurance and shall not be taken into consideration in the adjustment of any loss payable under this insurance.

7. TREES EXCLUDED FROM INSURANCE

This insurance does not cover trees which at the time of occurrence of the loss:

i) are or have been attacked or damaged by white ants or other insect pests, or
ii) are suffering from any fungoid growth or other organic or constitutional diseases; or
iii) have died for any reason except by operation of any of the insured perils during the currency of this Policy; or
iv) are or have been damaged or destroyed at any time by use of any weed killers or insecticides or pesticides.
No claim for loss or damage to such trees shall be recoverable hereunder.

8. CONTROL OF UNDERGROWTH

It is warranted that at all times during the currency of this Policy, the Insured shall take all reasonable steps to keep the ground comprising of the estates containing the trees hereby insured well maintained. Controlled forestry growths and/or cover crops are permitted without prejudice to this insurance provided that efficient control of all cover plants be maintained at all times.

9. MAINTENANCE OF FIRE BREAKS

All fire breaks shall be thoroughly cleaned and maintained at all times.

10. EXCLUDED PERILS

10.1This insurance does not cover:-

(a) Loss or damage occasioned by or through or in consequence of:

i) the burning of property by order of any public authority
ii) subterranean fire and /or Peat fire
iii) seepage and pollution caused by toxic chemicals or fumes;

(b) Loss or damage directly or indirectly caused by or arising from or in consequence of or contributed to by nuclear weapons materials;

(c) Loss or damage directly or indirectly caused by or arising from or in consequence of or contributed to by ionising radiations or contamination by radioactivity from any nuclear fuel or from any nuclear waste from the combustion of nuclear fuel. For the purposes of this Condition 10.1(c) combustion shall include any self-sustaining process of nuclear fission; and

(d) Consequential loss or loss of earning of any kind.

10.2This insurance does not cover any loss or damage occasioned by or through or in consequence, directly or indirectly, of any of the following occurrence namely:-

(a) Earthquake, volcanic eruption or other convulsion of nature;

(b) Subsidence or landslide;

(c) Flood or inundation unless specifically stated in the Schedule;

For this purpose, Flood shall be defined as the overflowing or deviation from their normal channels of either natural or artificial water courses, bursting or overflowing of public water mains and any other unexpected flow or accumulation of water; but excluding loss or damage caused by subsidence or landslip even where caused by Flood.

(d) Windstorm unless specifically stated in the Schedule;

(e) Damage by animals (domestic or wild) unless specifically stated in the Schedule;

(f) Damage by mechanically driven vehicles and aircrafts;

(g) War, invasion, act of foreign enemy, hostilities or war-like operations(whether war be declared or not), civil war;

(h) Mutiny, military or popular rising, insurrection, rebellion, revolution, military or usurped power, martial law or state of siege or any of the events or causes which determine the proclamation or maintenance of martial law or state of siege; and

(i) any act of terrorism

For this purpose an act of terrorism means an act, including but not limited to the use of force or violence and/or the threat thereof, of any person or group(s) of persons, whether acting alone or on behalf of or in conjunction with any organisation(s) or government(s), committed for political, religious, ideological or similar purposes including the intention to influence any government and/or to put the public, or any section of the public in fear

(j) Riot, Strike and Malicious Damage
Any loss or damage happening during the existence of abnormal conditions (whether physical or otherwise) which are occasioned by or through or in consequence, directly or indirectly, of any of the said occurrence shall be deemed to be loss or damage which is not covered by this insurance, except to the extent that the Insured shall prove that such loss or damage happened independently of the existence of such abnormal conditions.
In any action, suit or other proceeding where the Company alleges that by reason of the provisions of this condition any loss or damage is not covered by this insurance, the burden of proving that such loss or damage is covered shall be upon the Insured

11. EXCLUSION OF FIRE DAMAGE CAUSED BY BURNING WITHIN ESTATE

This insurance does not cover loss or damage to growing trees hereby insured when such loss or damage is caused by or through or in consequence of the burning through human intervention, of undergrowth, pampas or jungle and/or clearing by fire of any of the land forming part of the estates containing the trees insured hereunder. However, if the fire originates outside the estates covered by this Policy, the resulting loss or damage by spread of such fire to the trees insured hereunder will be payable in terms of this insurance.

12. EXCESS

The Insured shall first bear an amount specified in the Schedule on each and every loss caused by any insured peril after adjustments in terms of paragraphs 18 and 19 below and the Company shall only be liable for any amount in excess of the said first loss amount.

13. DEFINITION OF EACH AND EVERY LOSS

The words "each and every loss" shall mean the aggregate of all individual losses arising out of and directly occassioned by a single source of ignition for fire losses and include all losses arising out of the same fire until it is fully extinguished.

In case of windstorm, "each and every loss" shall mean the aggregate of all individual losses arising out of and directly caused by the operation of the said peril during a period of 72 consecutive hours. The Insured may choose the date and time when any such period of consecutive hours commences and if any peril is of greater duration, the Insured may divide that loss into two or more loss occurrences provided no two periods overlap and no period commences earlier than the date and time of the happening of the first recorded individual loss to the Insured by that peril.

In case of other perils, "each and every loss" shall mean the aggregate of all individual losses arising out of and directly caused by the operations of the said peril during a period of 24 consecutive hours and in case of flood will continue till ground surface is reasonably clear of water.

14. CLAIMS PROCEDURE

On the happening of any loss or damage the Insured shall forthwith give notice thereof to the Company, and shall within 15 days after the loss or damage, or such further time as the company may in writing allow in that behalf, deliver to the Company:-

(a) A claim in writing for the loss or damage containing as particular an account as may be reasonably practicable of all the trees damaged or destroyed, and of the amount of the loss or damage therein respectively, having regard to their value at the time of the loss or damage, not including profit of any kind;

(b) Particulars of all other insurances, if any;

(c) The Insured shall also at all times at his own expense, produce, procure and give to the Company all such further particulars, plans, specifications, books, vouchers, invoices, duplicates or copies thereof, documents, proofs and information with respect to the claim and the origin and cause of damage, and any matter touching the liability or the amount of the liability of the Company as may reasonably required by or on behalf of the Company together with a declaration on oath or in other legal form of the truth of the claim and of any matters connected therewith.

No claim under this Policy shall be payable unless the terms of this Condition have been complied with.

15. INSURER'S RIGHTS

On the happening of any loss or damage to any of the property insured by this Policy, the Company shall have access to any such property and freedom to examine the same. The Insured shall not deal with or dispose of the damaged property without the agreement of the Company. However, the Insured shall take all reasonable measures to avoid or minimise the loss.

The powers conferred by this condition shall be exercisable by the Company at any time until notice in writing is given by the Insured that he makes no claim under the Policy or, if any claim is made, until such claim is finally determined or withdrawn and the Company shall not by an act done in the exercise or purported exercise of its powers hereunder, incur any liability to the Insured or diminish its right to rely upon any of the conditions of this Policy in answer to any claim.

If the Insured or any person on his behalf shall not comply with the requirements of the Company or shall hinder or obstruct the Company in the exercise of its powers hereunder, all benefits under this Policy shall be forfeited.

The Insured shall not in any case be entitled to abandon any property to the Company whether taken possession of by the Company or not.

16. FRAUD

If the claim be in any respect fraudulent, or if any false declaration be made or used in support thereof, or if any fraudulent means or devices are used by the Insured or any one acting on his behalf to obtain any benefit under this Policy; or, if the loss or damage be occasioned by the wilful act, or with the connivance of the Insured; or, if the claim be made and rejected and an action or suit be not commenced within three months after such rejection, or in the case of an arbitrator or umpire shall have made their award, all benefits under this Policy shall be forfeited.

17. SUBROGATION

The Insured shall, at the expense of the Company, do, and concur in doing, and permit to be done, all such acts and things as may be necessary or reasonably required by the Company for the purpose of enforcing any rights and remedies, or of obtaining relief or indemnity from other parties to which the Company shall be or would become entitled or subrogated upon its paying for or making good any loss or damage under this Policy, whether such acts and things shall be or become necessary or be required before or after his indemnification by the Company.

18. CONTRIBUTION

If at the time of any loss or damage happening to any property hereby insured, there be any other subsisting insurance or insurances, whether effected by the Insured or by any other person or persons, covering the same property, this Company shall not be liable to pay or contribute more than its rateable proportion of such loss or damage.

19. DEFINITION OF EXTENT OF LOSS

In the event of a claim being admitted under this Policy, the quantum of loss shall be derived by applying the loss settlement scale appended to this Policy to the trees damaged or destroyed by the event. If the value of trees in the area damaged be more than the value mentioned in the Schedule for that area, the Insured shall be considered to be his own insurer for the difference and shall bear a rateable proportion of the loss accordingly.

20. TIME LIMITATION

In no case whatsoever shall the Company be liable for any loss or damage after the expiration of twelve months from the happening of the loss or damage unless the claim is the subject of pending action or arbitration.

21. CANCELLATION

This insurance may be terminated at any time by the Insured on notice to the Company in which case the Company will retain the customary short period rate for the time the insurance has been in force. However, no refund of premium will be allowed, upon termination by the Insured, where a claim has occurred during the currency of this insurance.

This insurance may also be terminated at the option of the Company by sending 14 days' notice by registered letter to the Insured at his last known address, in which case the Company shall be liable to repay on demand a rateable proportion of the premium for the unexpired term from the date of cancelment.

22. CHANGE OF RISK

If the interest in the property insured passes from the Insured otherwise than by will or operation of law, the insurance ceases to attach unless the Insured, before the occurrence of any loss or damage, obtains the sanction of the Company signified by endorsement upon the Policy, by or on behalf of the Company.

ARBITRATION

If any difference arises as to the amount of any loss or damage, such difference shall independently of all questions, be referred to the decision of an arbitrator, to be appointed in writing by the parties in difference, or, if they cannot agree upon a single arbitrator, to the decision of two disinterested persons as arbitrators, of whom one shall be appointed in writing by each of the parties within two calendar months after having been required so to do in writing by the other party. In case either party shall refuse or fail to appoint an arbitrator within two calendar months after receipt of notice in writing requiring an appointment, the other party shall be at liberty to appoint a sole arbitrator, and in case of disagreement between the arbitrators, the difference shall be referred to the decision of an umpire who shall have been appointed by them in writing before entering on the reference and who shall sit with the arbitrators and preside at their meetings. The death of any party shall not revoke or affect the authority or powers of the arbitrator, arbitrators or umpire respectively; and in the event of death of an arbitrator or umpire another shall in each case be appointed in his stead by the party or arbitrators (as the case may be) by whom the arbitrator or umpire so dying was appointed. The costs of the reference and of the award shall be at the discretion of the arbitrator, arbitrators or umpire making the award. And it is expressly stipulated and declared that it shall be a condition precedent to any right of action or suit upon this Policy that the award by such arbitrator, arbitrators or umpire of the amount of the loss or damage if disputed shall be first obtained.

The seat of arbitration shall be in Malaysia and the arbitration tribunal shall apply the laws of Malaysia as the proper law of this insurance.

24. NOTICE

Every notice and other communication to the Company required by these Conditions must be written or printed.

LOSS SETTLEMENT SCALE (COCOA)

1. Trees whose tap roots are broken. 100%

2. Trees which are so affected by floods as to require replanting or rehabilitation . Cost of treatment but not exceeding 100%

3. Trees with more than 75% of its trunk or branches scorched or destroyed. 100%

4. Trees with more than 50% of its trunk or branches scorched or destroyed. 50%

5. Trees damaged to a smaller extent. Cost of treatment but not exceeding 25%

Note:

Where more than 75% of trees in a field or an area in the aggregate are destroyed to an extent requiring replanting, the entire field or area will be treated as a total loss provided the entire field or area is replanted.

LOSS SETTLEMENT SCALE (RUBBER)

1. Trees whose tap roots are broken 100%

2. Trees which are destroyed by stagnant water 100%

3. Trees with more than 75% of the bark destroyed up to a height of 10 feet 100%

4. Trees with more than 50% of the bark destroyed up to a height of 10 feet 50%

5. Trees damaged to a smaller extent Cost of treatment but not exceeding 25%

Note:

Where more than 75% of trees in a field or an area in the aggregate are destroyed to an extent requiring replanting, the entire field or area will be treated as a total loss provided the entire field or area is replanted.

LOSS SETTLEMENT SCALE (OIL PALM)

1. Trees whose crown are destroyed 100%

2. Trees whose fronds are destroyed to the extent of 50% or more 50%

3. Trees damaged to a smaller extent Cost of treatment but not exceeding 25%

Note:

Where more than 75% of trees in a field or an area in the aggregate are destroyed to an extent requiring replanting, the entire field or area will be treated as a total loss provided the entire field or area is replanted.

Annex 10. Named Peril Windstorm Policy for Rubber Trees (China)

China has operates a typhoon windstorm insurance cover for rubber for a number of years. China is a major producer of latex. Most of the rubber is grown in Hainan Island and is highly exposed to seasonal typhoon damage from Eastern Pacific Tropical Cyclones.

The Peoples Insurance Company of China, PICC, Ltd, has for a number of years operated a named peril (windstorm – defined as Tropical Storm wind speeds and greater) damage-based indemnity policy for rubber plantations. The policy covers physical loss or damage to the rubber trees including snapping of the main tree-trunk, toppling of the tree and or lodging of the tree. The policy carries a very low sum insured per tree and which would only be adequate to cover the costs of replanting new seedlings. Loss assessment involves the in-field individual assessment of individual damaged tress according to the insured definitions of damage or loss. (See Box below for further features of PCIC Rubber wind-damage policy).

The sum insured and definition of damage and corresponding indemnity payments according to severity of damage would all need to be reassessed for PNG in order to reflect the economics of rubber production and localised wind storm exposures.

Box A10. 1. China: Rubber Tree Named-Peril Wind Damage Policy

Insured: Rubber Trees no less than 5 years age cultivated by state-owned farms, collective organizations, individuals or other organizations

Basis of Insurance and Indemnity. Damage-based Policy

Insured Perils: Tropical windstorm, strong tropical windstorm, typhoon or tornado which cases direct physical damage or loss to the rubber trees as defined in item 3. This policy does not insure against localised windstorm or wind speeds of less than 39 mph or 17 m/s.

Insured Damage caused by wind, defined as: (a) breaking of the rubber tree stem, 2) lodging: the plant is leaning at an angle of <45º from the ground

Insurance Period: 00.00 hrs of the effective date of insurance and end at 24.00 hrs 31st December of the same year.

Basis of Sum Insured: A fixed amount of RMB 8 per uncut rubber tree (trees which are not in production) and RMB 10 per cut rubber tree which are producing latex rubber.

Basis of Indemnity:

(i) **Percentage compensation levels for different types of insured damage**:

Breaking of the tree trunk	Toppling of the Tree and/or lodging >45º	Lodging (leaning) of the Tree < 45º
Tree trunks broken < 2 metres above the ground = 100% indemnity	100% of the sum insured	30% of the sum insured
Tree trunks broken > 2 metres above the ground = 20% indemnity		

(ii) **Deductible structure**: 10% of the actual loss each and every loss. It is understood this is a 10% coinsurance on the gross value of the claim.

Maximum Limit of Indemnity - Loss Limit: If the accumulated indemnity reaches 3 times the insurance premium paid (300% loss ratio), the insurance policy shall automatically terminate.

Loss Assessment procedure: In-field total rubber tree counts to estimate percentage damage according to the above criteria.

Main Exclusions: FLEXA, pests & diseases, drought, flood, freeze, earthquake, avalanche and mudslide.

Other Key Conditions:

The Insured must declare and insure all its rubber trees grown in the same geographical location;

Premium is payable prior to inception.

Source: World Bank 2007b

Annex 11. International Experience with Macro-Level Weather Index Insurance for Food Security

Mexico

In 2003 Agroasemex the Mexican specialist parastatal crop reinsurer launched the first Macro-level catastrophe drought crop insurance index insurance program. Mexico is very exposed to catastrophe risk in agriculture including drought (80% of natural catastrophes), hurricanes (17%), excess rain/flood (2%) and Frost (1%). Since 1995 the Federal and State governments have operated a national natural disaster scheme under the FONDEN program which is designed to provide financial compensation to small rural farming families who are not eligible for private crop and livestock insurance. Between 1995 and 2003 the Federal Government and State governments paid out US$ 212 million and US$ 74 million respectively to small rural farmers under the FONDEN program. In 2003 as part of the FAPRAC (Fund for the Care of Rural Population Affected by Weather Contingencies), government contracted Agroasemex the parastatal agricultural insurer and reinsurer to substitute the ex-post disaster compensation programs with an ex-ante macro-level index insurance for catastrophe climatic perils (Agroasemex 2007; Alderman and Haque 2007). The pilot macro-WII program was launched in 2003 as a drought insurance index cover for small subsistence growers of maize and sorghum in Guanajuato state and who were below the threshold of insurability for commercial insurance in Mexico. The state government was the policy holder and was fully responsible for paying the premium and was then responsible for distributing payouts to the insured farmers in the command area. Since 2003 the catastrophe climate contingency insurance program has been massively scaled-up with the development of index products based on i) WII covers against drought, hurricane and frost, ii) AYII covers providing all risk loss of yield protection at a macro-level, and iii) NDVI-pasture index covers for livestock producers. Currently 30 of the 38 state governments in Mexico purchase climate contingency protection; for crops, 8 million hectares are insured with 3.2 million small subsistence farmers protected under the crop insurance programs and about 4.4 million head of livestock are insured under the NDVI pasture drought index program (SAGARPA 2010)[28].

Ethiopia

In 2006 the WFP with technical assistance from the World Bank's CRMG, designed a macro-drought index policy for the Government of Ethiopia which was designed as an ex-ante food security risk financing instrument to fund emergency food aid. A national agricultural drought index contract was constructed on the basis of historical rainfall data for 26 weather stations and showed a very high degree or 80% correlation between major catastrophe drought years and requirements for disaster food aid in the drought affected areas. In 2006, the drought insurance cover was placed as a derivative contract with Axa Re with a Total Sum Insured of US$ 7.1 million which was designed to provide emergency relief funding to 62,000 households in 10 to 15 of the most affected administrative districts of the country and USAID funded the insurance premium of US$ 930,000 (implied premium rate of 13%). In 2006, seasonal rainfall was above

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[28] SGARPA (Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food), Government of Mexico: http://www.sagarpa.gob.mx

the level which would trigger an indemnity payment and therefore there was no claim on the contract (WFP 2006). Following this Pilot, starting in 2007, WFP has assisted the Ethiopian Government to develop a broader drought risk management framework in the context of the Productive Safety Net Program (PSNP). The starting point was to assist Government to introduce an improved national and sub-national drought risk modelling system for famine early warning purposes termed LEAP (Livelihoods, Early Assessment and Protection) and to use this system to plan disbursements of emergency assistance to drought affected regions. Under the second phase of PSNP (2010 to 2014), a drought risk financing component has been added to the program, through the securing of US$ 160 million of contingent grant from the World Bank, the UK's Department for International Development (DFID) and USAID and which is earmarked for distribution if LEAP indicates rainfall deficit and impending drought. This contingent loan arrangement is preferred by government because it is cheaper than purchasing a macro-level weather index insurance or derivative product. (Hazell and Hess 2011; ARCPT 2011).

Malawi.

Malawi also provides an example of a Macro-level rainfall-deficit index product linked to expected national maize production and which is designed as part of Malawi's overall risk management and food security strategy. The product was designed for the Government of Malawi by the World Banks CRMG in conjunction with UK's DIFID which funded the premium costs of the product. The index uses rainfall data from 23 weather stations throughout the country and is based on the Government's own national maize yield forecasting model which in turn is based on the FAO's water balance crop model[29]. In 2008, the macro-drought index for maize was placed as a derivative contract with the World Bank Treasury and backed by reinsurance from a leading reinsurer. The index was constructed such that if the index fell to 10% below the historical average, the Government of Malawi would receive a maximum payout of up to US$ 5 million. The pilot contract was free of claims in 2008/09 (Hellmuth et al 2009). The Malawi drought index product was renewed in 2009/10 and 2010/11 which were again years with good rains and with no payouts. An innovative feature of the Malawi maize drought index program is the linking of drought index payouts with a "price hedge" call option for white maize which is placed with the SAFEX Commodity Derivatives market, Johannesburg Stock Exchange (Alderman and Haque 2007; CRMG 2009). However because the WII policy has not been triggered to date, neither has the price-risk option.

African Risk Capacity (ARC) Project Drought Index Proposal.

For the past two years the Commission of the African Union's Department of Rural Economy and Agriculture (AUC) and the World Food Program, WPF, have been collaborating on a project to create a Pan-African owned Pool Index Insurance Fund to underwrite catastrophe weather events, initially to cover drought, but which in future would be expanded to include other weather risks such as flood[30] (ARCPT 2011; Gabriel 2011). WFP estimate that a widespread catastrophe drought in sub-Saharan Africa could cost US$ 3 billion in emergency assistance. The objective of the Insurance Fund would be to provide national governments with immediate cash payments for food security purposes. The benefits of establishing an African Pool Index scheme centre on the fact that drought does not correlate simultaneously across all 42 African countries north and

[29] The FAO's model is based on the Water Requirement Satisfaction Index (WRSI) which is used to determine the level of water stress endured by a crop during its whole growing season and the expected yield response to water stress.

[30] This initiative is being supported by the Rockefeller Foundation, DFID, The Global Fund for Disaster Reduction and Recovery (GFDRR) of the World Bank and IFAD

south of the equator providing the opportunity to diversify risk through Pooling. AUC/WFP have developed a software, *AfricaRiskView* to model the drought risk exposure across each African country: preliminary findings suggest a 50% saving in the risk capital required by each country if drought risk is pooled rather than being borne separately by each country[31]. The AfricaRiskView model uses historical satellite rainfall data for each country to model the drought risk hazard on a country by country basis for risk quantification and rating purposes and this is combined with data on vulnerable populations to form a standardised approach for estimating response costs to drought. As such, the premiums will be country specific according to each country's actual drought risk exposure and retention and amount of compensation required. In order to establish the African Risk Capacity Pool, a minimum of 5 to 6 countries from distinct geographical regions of Africa would be required to make the risk pooling concept viable. An initial capitalisation of the Pool of about US$ 300 million is recommended and funding would be sought from participating governments and donors. Each country would define the level of drought risk funding it wants to insure under the ARC Pool and AfricaRiskView would set the premium accordingly. A layered risk financing approach would be adopted by ARC based on the three elements of individual country risk retention, ARC Pool Retention and finally risk transfer to international reinsurance or derivative and bond markets. Finally, it is envisaged that ARC would appoint its own Fund Management team and operating systems and procedures, drawing on the lessons and experiences of the Caribbean Catastrophe Risk Index Insurance Facility, CCRIF (ARCPT 2011).

Source: C Stutley 2012.

[31] The ARC Pool Drought Index Fund draws on the experience of the Caribbean Catastrophe Risk Insurance Facility. CCRIF was formed in 2007 by a group of 16 Caribbean Islands states formed the world's first multi-country catastrophe insurance pool reinsured in the capital markets to provide governments with immediate liquidity in the aftermath of hurricanes and earthquakes. The programme was designed with technical assistance from the World Bank. CCRIF currently does not insure agriculture specifically, but the index product could in principle be developed to respond to loss in agriculture as a sub-sector in each country. A key benefit of CCRIF is that by adopting a parametric or index approach to insuring and indemnifying hurricane and earthquake damage, claims payments can be settled very quickly following a catastrophic event. A further benefit for the 16 participating island governments is that by pooling risk CCRIF can purchase catastrophe reinsurance protection up to US$100 million of coverage for each insured peril at a much lower cost than if each island government tried to place its reinsurance requirements alone. For further details on CRIFF see http://www.ccrif.org/faq and CCRIF (2011). Following the success of the CCRIF, the World Bank and other institutions are now exploring the possibility of designing a similar natural disaster pool risk transfer facility for the 15 Pacific Island countries (PICs) under the Pacific Catastrophe Risk Financing Initiative (PCRFI).

Annex 12. Government Support to Agricultural Insurance: International Experience[32]

Origins of Agricultural Insurance

The origins of agricultural insurance can be traced back to France in the 18th century when groups of livestock farmers came together to form cooperative or mutual livestock insurance companies. Similarly crop-hail mutual insurers started in many European countries in the 19th century and these products were transferred by emigrants to the USA and Canada and Argentina in the late 19th century and early 20th century. The tendency since then has been for many of the mutuals to either fail because they lacked reinsurance protection against catastrophe losses, or to be replaced by private commercial companies, but leading examples of mutual insurers that continue to operate today include Austrian Hail, Groupama in France, the National Farmers Union in the UK, and several mutual insurers in the USA, South Africa and Argentina. In Mexico, the Fondos program for Self Insurance Groups represents an interesting mutual crop-credit insurance model for small crop and livestock producers.

Rationale for and Types of Government Support to Agricultural Insurance

The US Federal Crop Insurance Program represents one of the earliest examples of government intervention in the provision of public-sector crop insurance and its origin's date back to the early 1930's. In the 1980's there was a major expansion of public-sector crop insurance in developing countries including Central and Latin America, India and the Philippines. Most recently, since 2000, governments have increased their intervention in agricultural insurance both in developed markets in the USA and Europe (e.g. subsidized MPCI in France, and in emerging markets of Poland, and Romania) and especially in developing countries (e.g. new subsidized programs in China, South Korea, Brazil, Chile, and Turkey).

Reasons cited as to why governments should intervene in agricultural insurance markets often include:

a) Market failure: poorly developed insurance markets and non-availability of private-sector agricultural crop and livestock insurance;
b) Financial capacity constraints faced by private commercial insurers, particularly for systemic risk (drought, flood, epidemic diseases, etc);
c) High costs of insurance administration;
d) Inability of farmers to afford agricultural crop and livestock insurance premiums.

In 2010, agricultural crop and/or livestock insurance is available in over 100 countries and PPP programs are very common. Agricultural insurance is most developed in high income countries in North America, Europe, and Australasia. The programs in the USA and Canada carry very high levels of government financial support in the form of premium subsidies and subsidies on the operating and administration costs and reinsurance programs. In Europe about

[32] This Annex is based on Mahul and Stutley 2010 and draws on a survey of government support to agricultural insurance in 65 developed and less developed countries.

60% of the countries with agricultural insurance have subsidized PPP programs, of which the largest program is the Spanish national agricultural insurance scheme administered by Agroseguro and which is heavily subsidised. Italy and Portugal also represent market's where governments provide major financial subsidies to agricultural insurance and to a lesser extent this also applies to France. In the remaining 40% of European countries which are mainly crop hail markets, the programs are implemented exclusively by private commercial insurers with no form of government subsidies.

In Asia, public-sector agricultural insurance has a lengthy tradition in Japan, India and the Philippines, and public-private subsidized agricultural insurance is now being heavily promoted by government in South Korea and China which in 2010 is the second largest agricultural insurance market with total premium income of about US$2 billion. In Latin America many countries introduced public-sector agricultural insurance programs in the 1970's and 1980's, most of which have now been terminated and/or privatized. Today agricultural insurance is found in about 20 Latin American countries mostly under some form of PPP: the largest PPP programs are located in Brazil and Mexico where the commercial insurers receive a high level of premium subsidy and reinsurance support from government. Conversely Argentina has a very large private crop-hail insurance market and until recently had received no government premium subsidies whatsoever.

Agricultural insurance is poorly developed in most of Africa, the main exceptions being Mauritius, Sudan and Morocco where the programs operate with government support, and South Africa which has a well developed private and mutual company crop hail and MPCI insurance market with no government intervention.

Governments support to agricultural insurance takes different forms. Table A12.1. provides a summary of the types of government support to agricultural insurance in a sample of the major national agricultural (mainly crop) insurance programs from developed and developing countries and then Figure A12.1. presents a summary for 65 countries by geographic region of the different types of government support[33].

Public Sector vs. Private-Sector Agricultural Insurers. In the 1970's and 1980's many governments in developing countries created public sector agricultural insurers to underwrite highly subsidized multiple peril crop insurance for small-scale farmers. These public-sector programs tended to act as a major disincentive for the entry of private commercial insurers into agricultural insurance. The majority of the public-sector agricultural programs performed very poorly prompting governments to: (a) terminate the programs; or (b) take measures to strengthen and reform the public-sector programs; or (c) transfer responsibility for implementation to the private insurance sector[34]. It is noticeable that most of the new crop and livestock insurance programs which have been introduced in the past decade have been implemented by private commercial insurers with or without support from government, including Chile, Brazil, Colombia, Honduras, Sudan, South Korea (private mutual) and China.

In 2010, Canada is the only major developed nation where crop insurance continues to be provided through the provincial government public crop insurers. Conversely, a higher number of developing countries currently have public insurance companies including India, Philippines and Brazil (Table A12.1).

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[33] Mahul and Stutley 2010 survey of agricultural insurance provision in 65 countries.
[34] See Hazell et al 1986 for a comprehensive evaluation of the performance of public-sector subsidised agricultural insurance schemes and reasons for their failure.

Table A12.1. Government Support to Agricultural Insurance in 2010 – Major territories

Country	Year of Inception	Agricultural Insurance POOL (coinsurers)	Public-sector MPCI Insurer	Premium Subsidies	Subsidies on Administrative costs of crop insurance	Financial Support to R & D and Training	Public-Sector Crop Reinsurance
	Forms of Government Financial Support						
Developed:							
USA	1930's	No	No	Yes	Yes	Yes	Yes
Canada	1970's	No	Yes	Yes	Yes	Yes	Yes
Spain	1980	Yes	No	Yes	No	No	Yes
Portugal	1979	No	No	Yes	No	No	Yes
Italy	1970's	No	No	Yes	No	No	No
France	2005	No	No	Yes	No	No	No
Developing:							
India	1985	No	Yes	Yes	Yes	No	Yes
Philippines	1980	No	Yes	Yes	Yes	No	No
China	1950's	Yes	No	Yes	No	No	Yes
Brazil	1950's	No	Yes	Yes	Yes	No	Yes
Mexico	1990	No	No	Yes	No	Yes	Yes
Chile	2000	Yes(No)	No	Yes	No	Yes	No
Colombia	2000	No	No	Yes	No	No	No
S. Korea	2001	No	No	Yes	Yes	No	Yes
Turkey	2005	Yes	No	Yes	No	No	Yes

Source Author

Coinsurance Pools in Agricultural Insurance. In several countries government has promoted the formation of agricultural co-insurance pools of which the largest is the Agroseguro, Spain pool program formed in 1980. Since 2000 coinsurance pools have also been formed in Chile[35], Turkey and China (Table 1). Under several of the new CWII initiatives coinsurance pools have also been formed, including in Malawi, Thailand and Mongolia.

The most popular form of government support to agricultural insurance is through the provision of premium subsidies. Globally agricultural insurance premium subsidies are provided by governments on almost two-thirds of all countries with some form of agricultural insurance (Figure 1) and this is applicable to all the countries listed in Table 1.[36] Governments often justify premium subsidies as a means of making crop insurance affordable to all farmers and especially small farmers. The costs, however, of government premium subsidies are extremely high in most countries. In 2007-08, MPCI premium subsidies in the USA amounted to US$ 3.82 billion (58 percent of MPCI producer premiums), in Canada, US$ 546 million (50 percent of MPCI premium) and in Spain US$ 581 million (72 percent of total premiums). (Table A12.2). Other European countries with high premium subsidies include Italy and Portugal and Turkey and France have recently introduced premium subsidies as well. Similarly in Asia high levels of

[35] The Chilean Crop Insurance Pool has now been disbanded and the 2 main insurers operate independently.
[36] Legislation passed by the World Trade Organization, WTO over the past twenty years has been directed at phasing out all direct price support subsidies on agricultural commodities. Agricultural insurance premium subsidies are exempted (permitted) under Green Box legislation and many governments in Europe have used this loophole to increase their support to agricultural insurance premium subsidies.

premium subsidies apply to almost all the major programs including Japan (US$ 549 million premium subsidies or 50% of 2007-08 premiums), India, Philippines, China and South Korea. In China subsidized PPP agricultural insurance is expanding at a huge rate: in 2007-08 total agricultural insurance premium was US$ 682 million with premium subsidies of 283 million (41% of premium), but in 2009 premium is estimated at nearly US$ 2 billion with premium subsidies of about US$ 1.3 billion (65% subsidy level). In Latin America, Chile introduced premium subsides in 2001 and in Brazil, the federal government ratified the reintroduction of premium subsidies in 2005 and this has led to a major increase in agricultural insurance premiums from less than US$ 20 million in 2005 to over US$ 250 million in 2009/10.

Reinsurance support. The next most common form of government support is to the reinsurance of agriculture and applicable in nearly one third of countries (Figure A12.1). In India, government excess of loss reinsurance protection is free of any charge, while in Canada, USA and South Korea this is provided at favorable (subsidized) terms. In Spain, Mexico and Brazil agricultural reinsurance protection is provided at commercial market rates by the national reinsurers, Consorcio de Compensacion de Seguros (Spain), Agroasemex (Mexico) and the Brazilian Reinsurance Institute, IRB, (Brazil) and this also applies to Portugal where the government offers a voluntary crop stop loss reinsurance program.

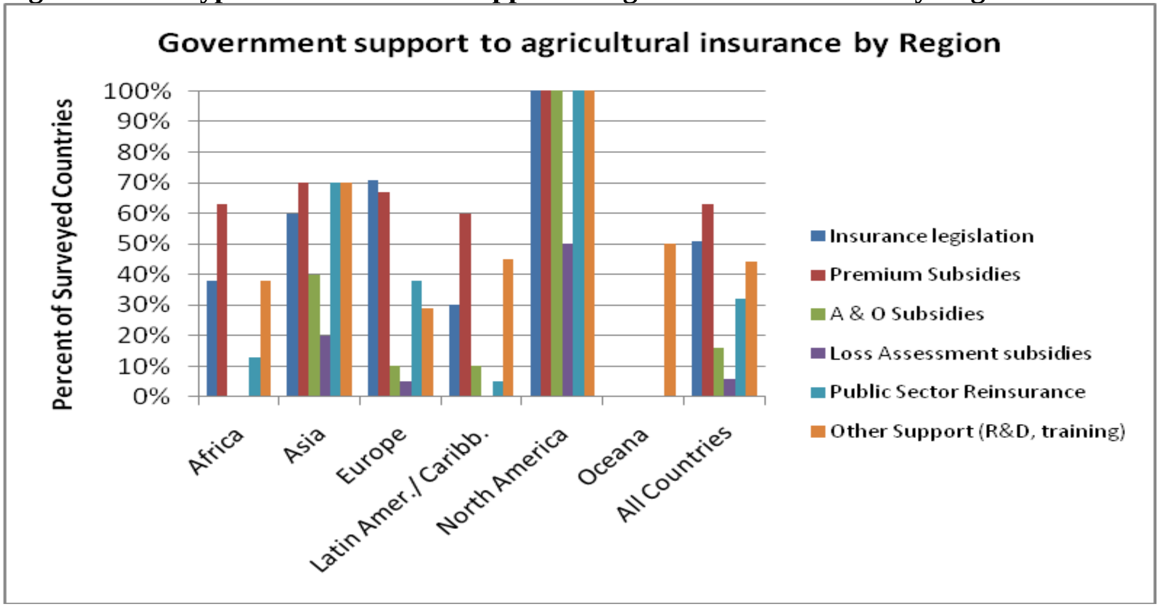
Subsidies on Administration and Operating expenses. In several countries government also offers subsidies on the insurance company's administration and operating (A&O) expenses. In the most comprehensive form in the USA, government effectively subsidizes 100 percent of insurer's acquisition costs, administration costs and the costs of adjusting crop losses. These subsidies are paid directly to the insurance company and the farmer only bears his share of the pure risk premium. Other countries which subsidies A&O expenses include India, Philippines and South Korea. (Table A12.1).

Table A12.2. Top 10 Global Insurance Market Premiums and Premium subsidy levels 2007-08

Country	**Type Agricultural Insurance Market**	**Govt. Premium Subsidies**	**Total agri-insurance premiums 2007 (US$)**	**% of Total Global Premium Volume**	**Agric. Insurance penetration (Premium as % 2007 Agric. GDP)**
United States	Public (MPCI); Private (Hail)	Very high	8,511	52%	5.2%
Japan	Public-Private Partnership	Very high	1,111	7%	1.8%
Canada	PUBLIC	High	1,090	7%	4.1%
Spain	Public-Private Partnership	Very high	809	5%	1.6%
China	Public-Private Partnership	Very high	682	4%	0.2%
Italy	Public-Private Partnership	Very high	383	2%	0.9%
France	Public-Private Partnership	Restricted	366	2%	0.6%
Russia	Public-Private Partnership	High	315	2%	0.6%
Iran	PUBLIC	Very High	241	1%	0.8%
Argentina	PRIVATE	Very restricted	240	1%	1.0%
Total top 10			13,746	83%	1.9%
		Total Global	**16,500**	**100%**	

Source: Mahul and Stutley 2010

Figure A12.1. Types of Government Support to Agricultural Insurance by Region



Source: Mahul and Stutley 2010

Other forms of government support to agricultural insurance. In some countries governments provide assistance in the form of agricultural insurance legislation and in the form of financial subsidies for product research and development and for training and education programs.

Comparative Performance, Subsidised and Non-Subsidised Agricultural Insurance

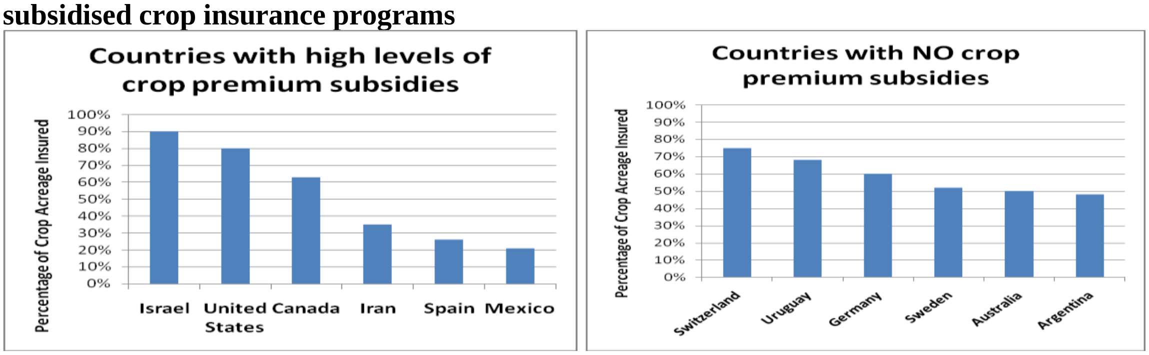
5.15. ***Although the World's largest agricultural insurance programs are those with subsidized PPP arrangements, there are also many important private commercial agricultural insurance programs which carry no premium subsidies or any other form of government support***. Table A12.3 shows that there are very import private, mainly crop hail and livestock insurance markets which do not carry any premium subsidies including USA (crop hail), Argentina, Australia, New Zealand and South Africa, the largest crop insurance market in Africa.

Table A12.3. Top 10 Private (unsubsidized) Agricultural Insurance Markets 2007-08

Country	Main Products	2007 Premium (US$ Mio)	% Global Premium
USA	Private Crop Hail	488	3.00%
Argentina	Crop Hail	240	1.50%
Germany	Crop Hail + Livestock	228	1.40%
Netherlands	Horticulture + Livestock	97	0.60%
Australia	Crops, Livestock, forestry	77	0.50%
Hungary	Crops and livestock	41	0.20%
Mauritius	Sugar Cane Windstorm	27	0.20%
New Zealand	Crops, Livestock, forestry	23	0.10%
South Africa	Crops and forestry	21	0.10%
Sweden	Crops	12	0.10%
Bulgaria	Crops and livestock	10	0.10%
Total top 10	**Global Premium US$ 16.5 bio**	**1,264**	**7.70%**

Premium subsidies are not always a precondition for high levels of insurance penetration. Premium subsidies are attractive both to farmers and to insurance companies, but they are not necessarily a precondition for the adoption of agricultural crop or livestock insurance. Figure A12.2 presents crop insurance penetration rates (insured crop area as a percentage of total cultivated area) for a sample of countries with premium subsidies and without premium subsidies. A notable feature of all of these countries which exhibit high levels of crop insurance adoption and penetration is that they have had crop insurance for more than 30 years and in some cases for well over a hundred years: the crop insurance markets are therefore very well developed and most farmers are fully conversant with the type and range of crop insurance products available.

Figure A12.2. Comparison of Crop insurance Penetration Rates, Subsidised and Un-subsidised crop insurance programs

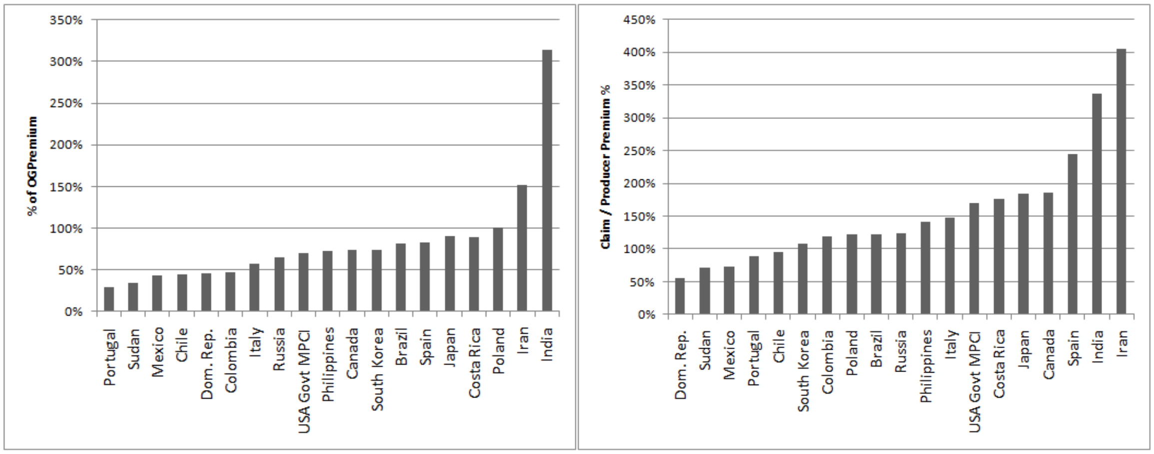


Source: Mahul and Stutley 2010

5.16. ***Currently most of the major subsidized PPP crop insurance programs operate at a financial loss ratio of less than 100%*** which means that the premiums they levy partly from farmers and partly from governments are adequate to cover their claims payouts over time. This is illustrated in Figure A12.3(a). However, if one considers only the "Producer loss ratio" namely the claims paid to the unsubsidized portion of the premium paid by the farmer, very few of these programs are operating profitably with a loss ratio of less than 100% (Figure A12.3(b).

Figure A12.3. Performance of Subsidised Crop Programs (5-Year average loss ratio 2003-07)

(a) Financial Loss Ratio (%) **(b) Producer Loss Ratio (%)**

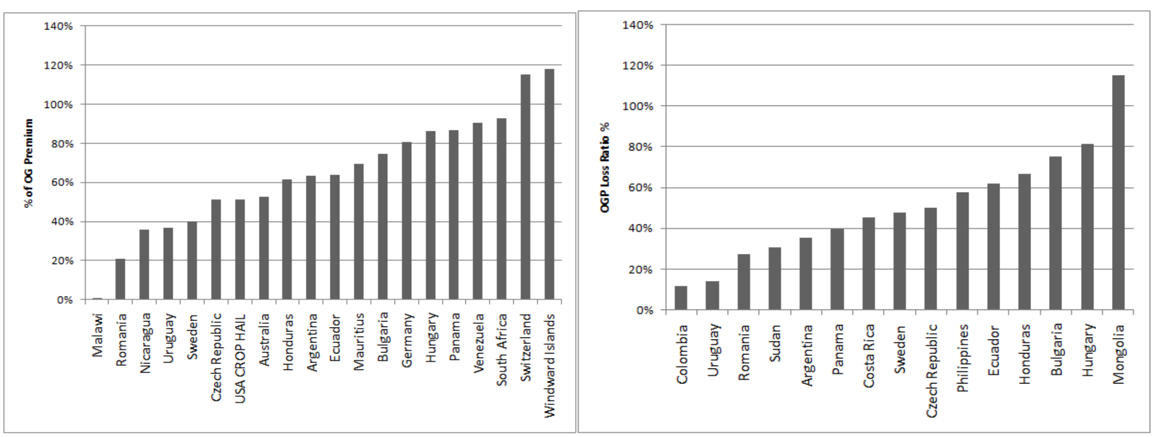


Source: Mahul and Stutley 2010

Private unsubsidized agricultural insurance programs often face higher commercial pressures than PPPs to achieve financial profitability. Figure A12.4 shows the 5-year (2003-2007) average loss ratios for a sample of private commercial crop and livestock programs, most of which have 5-year operating loss ratios of below 100%. Companies which are operating at loss ratios of above 80%, however, are not usually covering their business acquisition costs and their own A&O expenses and are not generating profits.

Figure A12.4. Performance of Unsubsidised Crop and Livestock Programs

(a) Crop Loss Ratio (2003-2007) **(b) Livestock Loss Ratio (2003-2007)**



Source: Mahul and Stutley 2010