



Vanuatu Klaemet Infomesen Blong Redy, Adapt Mo Protekt (Van-KIRAP)

Agricultural and Climate Information Services (CIS):
Policy Review, Action and Communication Plan





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Cover photograph: Luganville market. Photo Credit: Johanna Johnson.

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Acronyms

APCC	APEC Climate Centre
AWS	Automatic Weather Station
BoM	[Australian] Bureau of Meteorology
CDMS	Climate Data Management System
CIS	Climate Information Services
CLEWS	Climate Early Warning System
ClIDE	Climate Data for the Environment
ClIDesc	Climate Data for the Environment Services Application Client
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
DAL	Department of Agriculture and Livestock
DARD	Department of Agriculture and Rural Development
FAO	Food and Agricultural Organization of the United Nations
FSA	Farm Support Association (Oxfam NZ)
GCF	Green Climate Fund
GEF-LDCF	Global Environment Facility-Least Developed Countries Fund
GFCS	Global Framework for Climate Services
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (Germany)
NAPA	National Adaptation Programme for Action
NCCAS	[Vanuatu] National Climate Change Adaptation Strategy
NCOF	National Climate Outlook Forum
NDMO	National Disaster Management Office
NIWA	National Institute of Water and Atmospheric Research (New Zealand)
NOAA	National Oceanographic and Atmospheric Administration (USA)
NSDP	National Sustainable Development Plan 2016-2030
PRSCS	Pacific Roadmap for Strengthened Climate Services
SNC	[Republic of Vanuatu] Second National Communication to the UNFCC

SPREP	Secretariat of the Pacific Regional Environment Programme
UNDP	United Nations Development Programme
Van-KIRAP	Vanuatu Klaemet Infomesen blong redy, adapt mo protekt (formerly known as CISRDP: Climate Information Services for Resilient Development in Vanuatu Project)
VASP	Vanuatu Agriculture Sector Policy
VCAP	Vanuatu Coastal Adaptation Project
VCU	Vanuatu Climate Update
VFCS	Vanuatu Framework for Climate Services
VMGD	Vanuatu Meteorology and Geohazards Department
VMGD SDP	VMGD Strategic Development Plan

Executive Summary

The Vanuatu Klaemet Infomesen blong Redy, Adapt mo Protekt (Van-KIRAP) Project is delivering climate science to support decision makers and communities in Vanuatu to prepare for and adapt to climate variability and change. Although Vanuatu has been identified as a carbon sink, it is significantly affected already by changing weather patterns and the start of slow-onset climate change, such as warming oceans.

Assessments of vulnerability to climate change undertaken over the last two decades have identified Vanuatu as highly exposed to climate variability and change, and at risk of impacts, with the country ranked 9th globally under the Climate Risk Index for 1998–2017¹. The Government of Vanuatu and its development partners have developed policies and proposed strategies to improve Vanuatu's access to reliable climate information and to ensure it is used effectively to mitigate impacts. Both these objectives are expensive and difficult to achieve, and so the integration of climate information into planning processes has been slow.

Van-KIRAP will support VGMD to provide five target sectors, including the Department of Agriculture and its stakeholders with climate information ready to be used in current and planned activities. A sector Coordinator in the Department of Agriculture will co-ordinate the Agriculture and Climate Action and Communication Plan to advance the mainstreaming of climate information services into agricultural policy, planning, design and delivery.

This document reviews existing information on climate and climate change as they affect Vanuatu's agriculture sector and summarises current policies, strategies and frameworks. It provides the Agriculture Climate Action Plan and Communication Plan developed through a collaboration between the Department of Agriculture and the Vanuatu Meteorology and Geohazards Department (VMGD).

¹ German Watch (2019) Global Climate Risk Index 2019: Who Suffers Most from Extreme Weather Events? Weather-related loss events in 2017 and 1998 to 2017. Authors: David Eckstein, Marie-Lena Hutfils and Maik Winges, Munich, Germany.

1. Background

The VMGD, supported by the Secretariat of the Pacific Regional Environment Programme (SPREP) and funded by the Green Climate Fund (GCF) is leading the Vanuatu Klaemet Infomesen blong redy, adapt mo protekt (Van-KIRAP) Project.

Van-KIRAP “will increase the ability of decision makers, development partners, communities and individuals across five target sectors (agriculture, fisheries, infrastructure, tourism and water) to plan for and respond to the long- and short-term impacts of climate variability and change.

The project is building capacity to harness and manage climate data, develop and deliver practical Climate Information Services (CIS) tools, support the coordination and dissemination of tailored information, enhance CIS related information technology and infrastructure, improve the accessibility of CIS to sectors and communities, and support the application of CIS through real-time processes.

CIS provides people and organisations with timely, tailored climate-related information and tools that can be used to minimise the impacts of climate variability and change on lives, livelihoods, natural resources, property and infrastructure. CIS supports better policy, planning, and decision-making across sectors, and at national and community scales for both long- and short-term timeframes.

The Project is responding to priorities identified in the Vanuatu Framework for Climate Services (2016) and the VMGD Strategic Development Plan 2014–2023, developed through a national consultation and design process.

Without timely and tailored information about the impacts of climate variability and change, development sectors, governments and communities risk significant losses and damage from extreme events such as drought, heat waves, cyclones and flooding, and from slow onset changes, such as rising temperatures, sea-level rise and ocean acidification.²

In support of these objectives, Van-KIRAP commissioned the development of sector specific Climate Information Services (CIS) Action and Communication Plans. This document reflects the requirements of the fisheries sector as it relates to CIS in Vanuatu.

2. Climate in Vanuatu

Vanuatu is one of the world’s most vulnerable countries to natural disasters. It experiences droughts, floods, cyclones, volcanic eruptions, landslides, tsunami and coastal inundation. Its location in the ‘warm pool’ of the South Pacific Convergence Zone (SPCZ) means its population is highly exposed to cyclone activity.

The landscape is characterised by six island groups (Provinces), of mostly mountainous volcanic origin; steep catchments lead to narrow coastal plains vulnerable to flooding. It has a tropical climate, moderated by southeast trade winds from May to October, and moderate rainfall from November to April, often affected by cyclones from December to April. Vanuatu has a population of approximately

² SPREP, RFT: Climate Information Services Policy Review, Sector-Action and Communications Plan Consultancy, 2018

278,000 that is concentrated along the coastal environment that plays a vital role in the subsistence and commercial life of ni-Vanuatu.

Increased human activity in this coastal environment is placing greater pressure on sensitive areas such as beaches, coral reefs, seagrass and mangroves. Atolls, low-lying islands, and low-lying coastal areas of Vanuatu are particularly vulnerable to climate change consequences. Some of these climate related risks include the following:

- by 2040, daily temperatures will increase from 1995 levels by 1.2°C;
- sea level rise will continue and accelerate, so risks of coastal inundation will be high when combined with storm surges and high seas;
- ocean acidification may degrade 80% of coral reefs within 20 years;
- extreme temperatures will reach higher levels and become more frequent;
- extreme weather events, including cyclones and storms, will increase in intensity but not necessarily in frequency; and
- dry periods will last longer and extreme rainfall will be more frequent and intense, so Vanuatu will be susceptible to intensified erosion and flooding.

The economy is based primarily on small-scale agriculture, which provides a living for about two-thirds of the population (and is a particular source of income and livelihood for women). Fishing, offshore financial services, and tourism (with nearly 197,000 visitors in 2008), are other mainstays of the economy. Most of the population does not have access to a reliable supply of potable water, though 94.5% has access to 'improved' water sources, and deforestation exists as a major environmental challenge.

The main climate hazards for Vanuatu include tropical cyclones with high winds and wave energy, heavy rainfall resulting in flooding, extended periods without rain causing drought, rising sea levels threatening coastal environments and property, as well as sea temperature increase and ocean acidification impacting highly valuable coastal ecosystems and resources (including coral reefs, seagrass and fisheries). Pacific region adaptation costs across all vulnerable sectors are estimated to be between US\$158 – 775 million per annum until 2050 to prepare for best to worst case future scenarios (with US\$447 million under business-as-usual) (ADB 2013).³

3. Climate Services in Vanuatu

3.1 Vanuatu Meteorology and Geohazards Department (VMGD)

VMGD's mandate is decreed by the Meteorology, Geological Hazards and Climate Change Act — Act No.25 of 2016. The Act gives the VMGD wide ranging powers with respect to the execution of meteorological, geological and climate change related services.

VMGD is headed by the Director of VMGD, who is accountable to the Director General of the Ministry of Climate Change, Meteorology, Geo-Hazards, Energy, Environment and Disaster Management. The Director General is also co-chair of the National Advisory Board on Climate Change and Disaster Risk

³ SPREP, GCF Funding Proposal: Climate Information Services for Resilient Development in Vanuatu, 2016

Reduction (NAB) which facilitates and endorses the development of new Disaster Risk Reduction (DRR) and Climate Change (CC) programs, projects, initiatives and activities, acts as a focal point for information-sharing and coordination on CC/DRR, and guides and coordinates the development of national climate finance processes.⁴

VMGD is responsible for the collection, quality control, processing, storage and retrieval of meteorological and climatological data so that it may be utilised by a wide variety of stakeholders. One of its primary responsibilities is the preparation and publication of seasonal climate forecasts and long-term climate change predictions. VMGD provides technical expertise to the National Disaster Management Office (NDMO) and various climate-sensitive sectors during ENSO events, and disseminates advisories on significant climate events such as El Niño and La Niña. It also pursues climate variability and climate change research in support of national development strategies. In addition, VMGD has an active focus on community engagement, which includes raising awareness of its climate information and services, and how these might be utilised by various end-users.⁵

National Climate products from VMGD

1. Vanuatu Climate Update (VCU) – the VCU is produced monthly and is an outlook of expected climate for the upcoming three months. It includes information on seasonal rainfall, tropical cyclones and sea surface temperature. The VCU is disseminated via the VMGD website and email and comes in both English and Bislama.⁶
2. ENSO (El Niño–Southern Oscillation) update
3. Climate Services: Report for Agriculture – produced from AWS data at a site and available via the VMGD website
4. Media release – El Niño, or La Niña, TC outlook
5. Tropical Cyclone Outlook – usually released early November
6. Klaod Nausara Animation – explains the impacts of El Niño and La Niña in Bislama
7. Brochures – La Niña and El Niño in English
8. ENSO handbook (DVD, brochures and a games toolkit)
9. Vanuatu Ocean Outlook – in trial
10. Early Alert Rainfall Watch – in trial
11. Rainfall data request – rainfall, temperature, etc.

⁴ World Meteorological Organization (WMO), Enhancing Early Warning Systems to build greater resilience to hydro and meteorological hazards in Pacific Small Island Developing States (SIDS): National Consultation Report, Jan 2018

⁵ SPREP, GCF Funding Proposal: Climate Information Services for Resilient Development in Vanuatu, 2016

⁶ SPREP, Vanuatu Framework for Climate Services, 2016

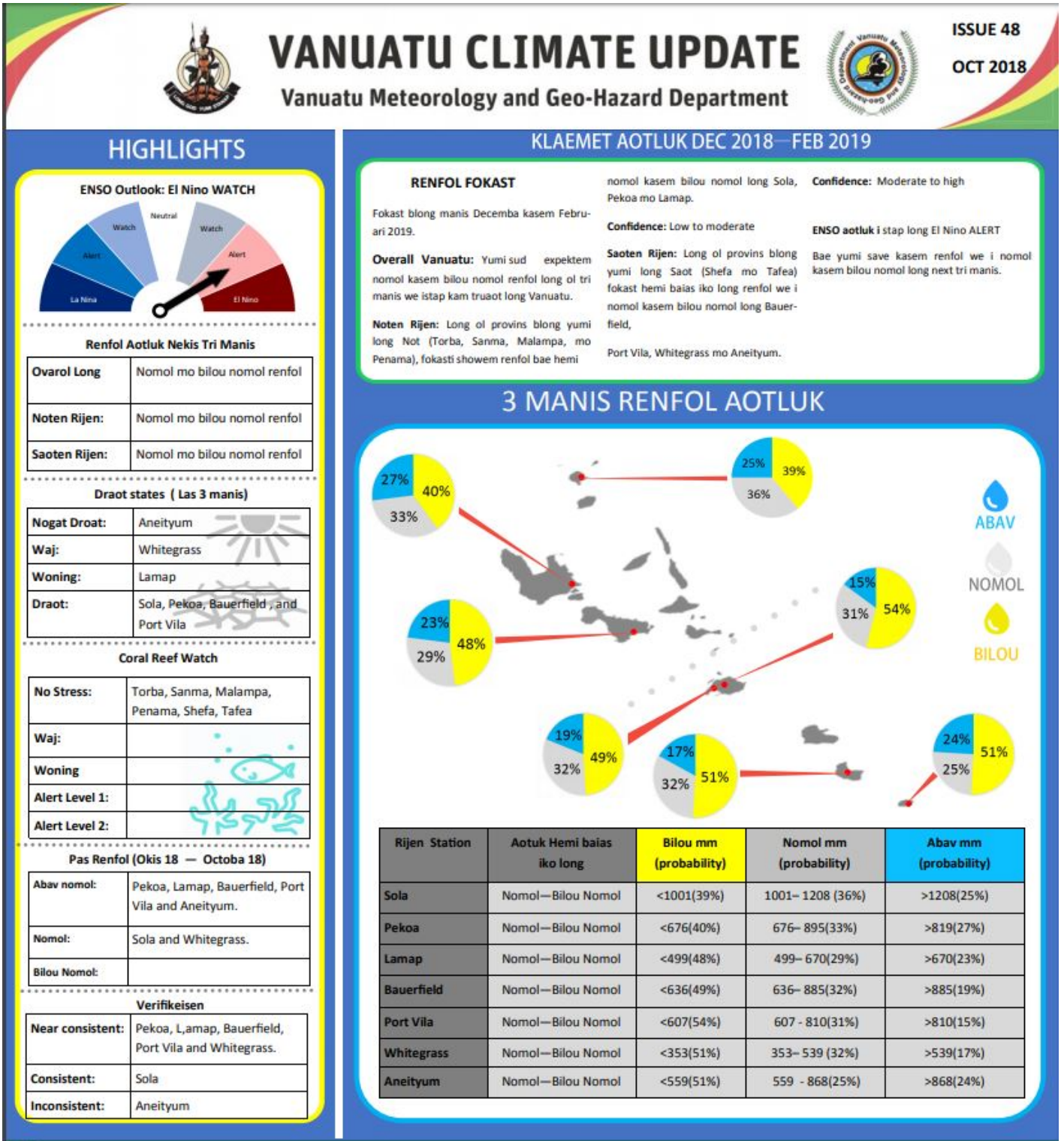


Figure 1: Vanuatu Climate Update (Source: VMGD)

Climate Services

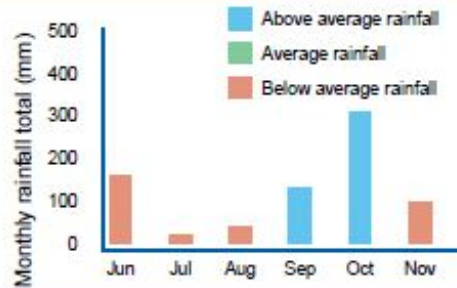
REPORT FOR AGRICULTURE, PORT VILA AWS

21 November 2018

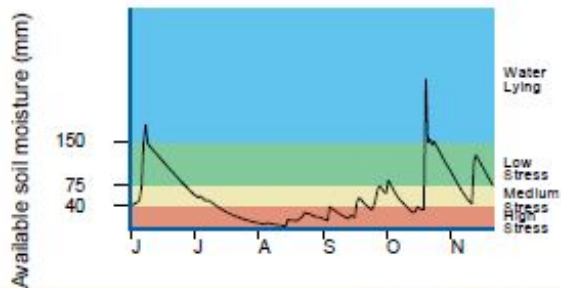


RAINFALL MONTH TO DATE

17 days without rain	76mm maximum daily rainfall
96mm total monthly rainfall	60% of average monthly rainfall



SOIL MOISTURE IN ROOT ZONE MONTH TO DATE



99mm available water start of month	75mm current available water
17 days of water stress	0 days of water runoff

AIR TEMPERATURE MONTH TO DATE

30°C maximum air temperature	19°C minimum air temperature
4 number of days above 30	0 number of days above 35



GROWING CONDITIONS FOR AGRICULTURE (PAST 90 DAYS)



Figure 2: Agrometeorological record for Port Vila for Agricultural sector provided by VMGD

National Climate stakeholder liaison by VMGD

1. VMGD Monthly climate briefings – Presentation on the climate summary and outlook information
2. VMGD 3-Monthly climate briefings – Presentation on the climate summary and outlook information
3. VMGD National Climate Outlook Forum
4. Media briefings – Radio talkback monthly

3.2 Regional climate products supported by partners

SPREP

1. Early Action Rainfall (EAR) Watch (request from VMGD)
2. Traditional Knowledge program (housed at VMGD) – survey form, database system
3. Climate Information Toolkit for the Pacific (<http://clikp.sprep.org/>) (supported by APCC)
4. Pacific Island Countries Advanced Seasonal Outlook (PICASO) – rainfall threshold predictions (<http://clikp.sprep.org/>) (supported by APCC)
5. SCOPIC/Seasonal Forecasting (in partnership with BoM) – 3 month prediction (<https://www.pacificmet.net/products-and-services/climate-bulletin>)

Australian Bureau of Meteorology (BoM)

1. COSPPac Bulletin (<https://www.pacificmet.net/products-and-services/climate-bulletin>)
2. SCOPIC/Seasonal Forecasting (in partnership with SPREP) – 3 month prediction (<https://www.pacificmet.net/products-and-services/climate-bulletin>)
3. Drought Monitoring Tool (allows to set thresholds for different water requirements)
4. ENSO Wrap-up (<http://www.bom.gov.au/climate/enso/>)
5. CliDE (climate data for the environment) (and CliDEsc which is supported by NIWA)
6. Sea-level information products (real time data monitoring and tide calendars)
7. Pacific Climate Change Data Portal (<http://www.bom.gov.au/climate/pccsp/>)
8. TC portal (<http://www.bom.gov.au/cyclone/history/tracks/>)
9. ACCESS-S dynamic model (in development) – outlook for season, month, fortnight and week
10. POAMA dynamic model – 3 to 9 month forecasts (SST+, hot spots, bleaching risk etc.)
11. ReefTemp Next Gen – 1 to 14 days SST, SST+, hot spots and bleaching risk maps)
12. Pacific Ocean Portal (now supported by SPC)

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

1. Climatology of Vanuatu: Past, present and future
2. Technical Report and non-technical country brochure
3. Regional Climate Consortium in Asia-Pacific (RCCAP) Portal
4. Websites and portals:
 - www.pacificclimatechangescience.org
 - www.pacificclimatefutures.net
 - www.pacificmet.net/rcc
 - www.rccap.org

Other Organisations

1. Tide Predictions Calendar (<http://www.bom.gov.au/pacific/projects/pslm/>) (SPC)
2. Pacific Ocean Portal (previously BoM)
3. RiskScape – Land-use planning tool that includes sea level, rainfall, elevation (NIWA)
4. Coral Reef Watch – 9-month SST+ and bleaching projections (NOAA & used by VMGD for Ocean Outlook) (<https://coralreefwatch.noaa.gov/satellite/baa.php>)
5. Bleaching Futures – downscaled coral bleaching return interval projections to 2100 for Vanuatu (NOAA/Symbioseas).

3.3 Climate institutional arrangements relating to agriculture

There is a close relationship between VMGD and the Department of Agriculture and Livestock. The Vanuatu Climate Update and the Monthly Climate Summary are sent to all Agriculture and Livestock staff by email, and representatives regularly attend the Climate Briefings. Climate field schools are run in all the provinces and include training on modifying agricultural practices (including planting different crops and varieties) during drier- and wetter-than-normal conditions. These climate field schools are jointly delivered by VMGD and the Department of Agriculture and are a direct result of the 2012 MOU signed between these two Departments.⁷

4. Agriculture in Vanuatu

Vanuatu enjoys considerable land-based resources, fertile soils, and extensive (although declining) forests. Agriculture is one of the most productive sectors, providing for over 25% of the country's GDP. Copra and cocoa are the cash crops produced, with subsistence emphasis placed on taro and yams.⁸

Vanuatu is an agriculture-based economy in which 80% of the population depends entirely on subsistence agriculture for their daily sustenance and well-being. Although the other 20% reside in the urban areas, most would still rely on agricultural products from market centers for their daily source of nutrients. The 2009 census estimated the population to be 234,023 people inhabiting over 80 islands. With a population growth rate of 2.3%, Vanuatu has one of the highest population growth rates in the world. On the rapidly urbanising Island of Efate, population growth rate is 3.7%. The 2009 census shows that despite a 30.1% increase in the total number of households from 1999, there has been a considerable decline in the number of households actively engaged in the major cash crop agriculture.⁹

⁷ SPREP, Vanuatu Framework for Climate Services, 2016

⁸ World Bank, Climate Risk and Adaptation Country Profile: Vanuatu, 2011

⁹ Government of the Republic of Vanuatu, Vanuatu Agriculture Sector Policy, 2014

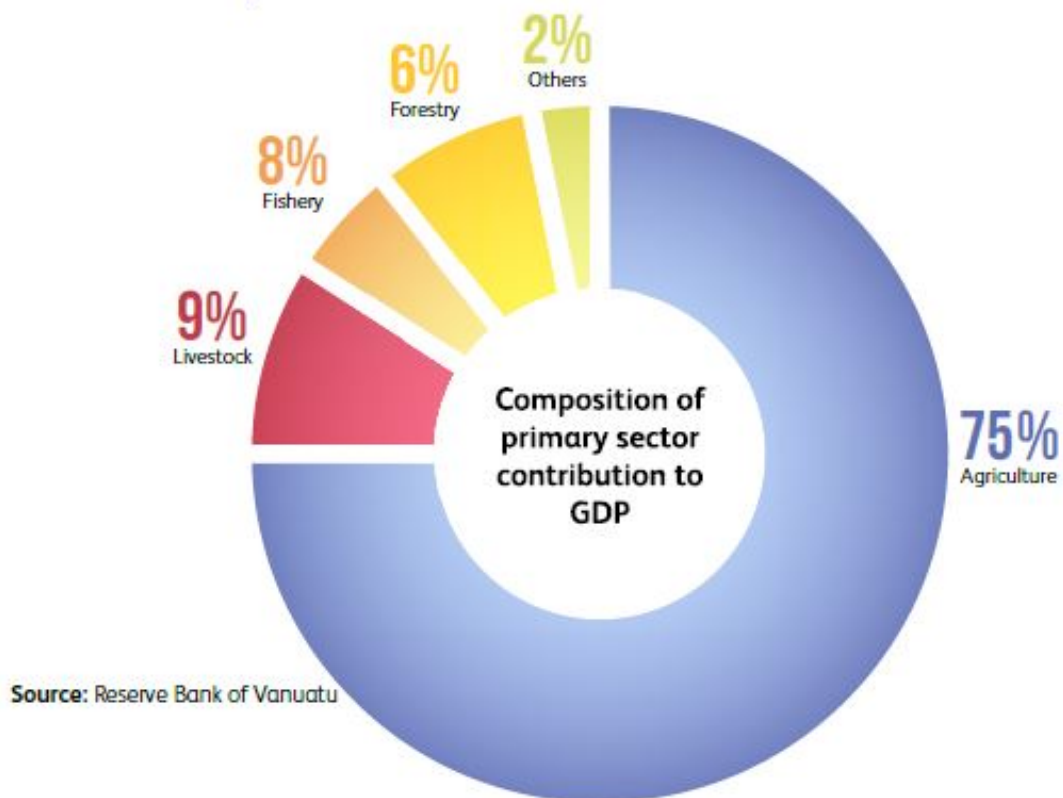


Figure 3: Graphic composition of Vanuatu Primary Industry

Vanuatu's agriculture sector is divided into three distinctive subsectors with the subsistence sector accounting for more than 75% and a growing semi-commercial sector contributing to around 15%. An agriculture commercial subsector based on a limited range of traditional cash crops but having the potential for expanding into the emerging vegetable market contributes to around 10% of total production in the sector.

The subsistence sub-sector is predominantly centred around root crops (taro, yam, cassava and sweet potato (*Ipomoea batatas*)) for consumption and cultural purposes and characterized by a total reliance on rain irrigation and rudimentary implements/tools. This subsector of agriculture is labour intensive but utilises completely organic farming practices. There exists a notable level of risk and uncertainty regarding the magnitude of potential yield at any given time thus giving rise to food insecurity and vulnerability to shocks. The risks of food insecurity are further exacerbated by a rapid increase in imported foodstuffs.

The bulk of semi-commercial agricultural activities are concentrated near urban centres where high population growth rates, the development of the tourism industry, and high rates of urban unemployment sustain a growing agricultural market for food crops. Recently there has been an expansion of green leafy vegetables in diets complementing the popular open pollinated local island cabbage (*Abelmoschus manihot*), including varieties of hybrid Chinese cabbages (*Brassica rapa subsp. chinensis*), tomatoes (*Lycopersicon esculentum*), capsicum and eggplant (*Solanum melongena*). Spice

and herb cultivation in this subsector is a new but promising industry being led by women farmers, with potential for engagement by other vulnerable groups.

The commercial subsector is dominated by 4 main cash crops: 24% of ni-Vanuatu households are engaged in cocoa production, 50% in kava, 2% in coffee and 69% in coconut. The 2009 population census noted two other emerging cash crops, namely pepper and vanilla in which 1.5% and 15% of households were engaged. While there has been a slight increase in the number of households growing coffee, the census also registered a significant drop in the number of households planting kava, coconut and cocoa. Such a decline may be related to fluctuations in world commodity prices, emerging markets for novel crops, loss of basic farming skills/knowledge or conversion of prime agricultural land near urban areas into residential estates to cater for rapidly expanding urban populations.¹⁰

Copra is Vanuatu's main agricultural export commodity outweighing the contribution of cocoa and kava by a large degree. Despite this dominancy, there is a general observation that in all the major copra producing islands, coconut rehabilitation programs have remained stagnant over the last 30 years with only a very small percentage of farmers engaging in coconut replanting programs.

Over the last 10 years, world prices for cocoa have greatly increased and on the domestic market the demand for kava has remained very high. The production of kava is still very high while cocoa is on the decline over the last 10 years. The local consumption of kava is huge although a definitive figure has never been given to this market sector. However, it is estimated that local sales value is about 3 times the value of exports. This trend is likely due to the current high demand in the domestic market for vegetables and other short-term crops (to supply a growing tourism sector) and is causing a notable shift in agricultural crops used. These short-term crops are also beneficial for addressing food insecurity and other risks associated with traditional longer growing crops.¹¹

4.1 Agricultural services in Vanuatu

4.1.1 Agricultural institutional arrangements relating to climate

The Department of Agriculture and Livestock uses the Vanuatu Climate Outlook, ENSO update and the Early Alert Rainfall Watch provided by VMGD. They have also developed a new quarterly Agriculture bulletin which includes information on the seasonal climate outlook. Special leaflets are published (e.g. on mulching techniques, agroforestry, key information for dry periods (El Niño) etc.) which are specifically designed to help farmers during times of climatic stress such as drought.¹²

The Department of Agriculture and Livestock has well-established provincial and community-based networks that can be used for the dissemination of tailored climate information.¹³

¹⁰ Government of the Republic of Vanuatu, Vanuatu Agriculture Sector Policy, 2014

¹¹ Government of the Republic of Vanuatu, Vanuatu Agriculture Sector Policy, 2014

¹² SPREP, Vanuatu Framework for Climate Services, 2016

¹³ SPREP, Vanuatu Framework for Climate Services, 2016

4.1.2 Memorandum of Understanding between VMGD and the Department of Agriculture and Rural Development (DARD)

VMGD and DARD have signed a MoU on the implementation of Climate Information Services for Resilient Development under Van-KIRAP. The MoU states that “the parties (in this case assuming both VMGD and DARD) agree to the extent possible, but without limitation, to obtain data on vegetables, root crops, fruiting plants, soil, farming techniques and data generally relating to crop growth, livestock and yields from DARD databases, and from other agriculture projects that have direct or indirect associations with climate.¹⁴

DARD shares this data with VGMD:

- a) To support VMGD to provide tailored seasonal forecasts for climate variability of atmospheric and ocean conditions (e.g. rainfall, wind, air temperature, SST, sea level, degree heating days, cyclones and storms);
- b) To provide monthly climate and ocean bulletins;
- c) Capacity building for VMGD and DARD representatives on data management, analysis and interpretation;
- d) Inform the development and implementation of the Agriculture/Agrometeorology case study;
- e) To provide ‘hotspot’ localities of climate hazard hotspot risk areas associated with agriculture;
- f) To customise Climate Information Services (CIS) and operationalise Decision Support Tools for DARD; and
- g) VMGD to provide other climate data to DARD on request.

4.2 Main climate impacts on agriculture

In Vanuatu, agriculture often relies on rain-fed agricultural production systems. Any changes in rainfall distribution, both in terms of the amounts of rain and its spatial as well as temporal distribution could have severe impacts on agricultural production. Intense and prolonged rainfall in planting seasons could damage seedlings, reduce growth and provide conditions that promote plant pests and diseases. Moreover, this could lead to greater frequency and intensity of flash floods leading to soil erosion and flooding of agricultural land. Drought combined with higher temperatures would lead to greater evaporation, reduced availability of water for agriculture and added thermal stress on plants.¹⁵

More pronounced dry seasons, warmer temperatures and greater evaporation could stress plants reducing productivity and harvests.¹⁶ In some cases a decline in crop production can be related to climate-vulnerable varieties of crops.¹⁷ Changing precipitation patterns are influencing agricultural

¹⁴ Memorandum of Understanding on the implementation of Climate Information Services for Resilient Development (CISRDP) Project: Van-KIRAP

¹⁵ Government of the Republic of Vanuatu, National Adaptation Programme for Action (NAPA), 2007

¹⁶ Global Environment Fund (GEF), Pacific Adaptation to Climate Change (PACC): Vanuatu, 2010

¹⁷ Government of the Republic of Vanuatu, Vanuatu Agriculture Sector Policy, 2014

planting, maintenance and harvesting methods, as well as the production capability of agricultural systems.¹⁸

Prolonged heavy rainfall (i.e. more rainfall than normal over periods of a few weeks to several months) causes waterlogging leading to crop failures and problems with soil pugging by large animals. Very wet or very dry conditions encourage build-up of pests and disease outbreaks, fungal and viral diseases, and invasive species (e.g. big leaf vine prevents sunlight reaching other vegetation). Very hot conditions can impact the health of livestock.¹⁹ Climate factors that can also promote or inhibit plant growth and development include rainfall, water, sunlight, air temperature, relative humidity and wind.²⁰

“The impacts of climate variability and change on the agricultural sector include reduction in crop yields and damage from cyclonic activity, increases in evapotranspiration, changes in growing seasons and reduction in water availability. There is also growing evidence of soil erosion and loss of soil fertility due to improperly managed deforestation and environmental degradation²¹ as well as more pests and diseases of animals, crops and trees.²²

18 SPC/GIZ Coping with Climate change in the Pacific Island Region: Vanuatu Briefing Note, 2013

19 SPREP, Vanuatu Framework for Climate Services, 2016

20 Iesul, P., “National Climate Outlook Forum Presentation: El-Nino impacts on Agriculture sector and use of met services and products”, 2016

21 World Bank, Climate Risk and Adaptation Country Profile: Vanuatu, 2011

22 SPREP, Vanuatu Framework for Climate Services, 2016

Table 1: Summarises the current impacts, sensitivities to climate change as well as the current adaptive capacity²³

Sector Impacts	Agriculture – Crop Production	
	Current Sensitivity to Climate	Current Adaptive Capacity
<ul style="list-style-type: none"> • Droughts • Heat spells • Cyclones • Wind gusts • Floods • Sea level rise / salt water intrusion 	<ul style="list-style-type: none"> • Majority of ni-Vanuatu depend on agriculture (subsistence agriculture and limited cash cropping) • Small farm sizes • Little incentive to introduce modern equipment and methods • Low productivity • Commercial and subsistence agriculture are based on rain-fed agricultural production systems • Most farmers are isolated with poorly maintained access roads • Little additional information on CC-impacts on crops such as yams, taro and sweet potatoes • Lack of food storage and preservation • Lack of water storage facilities • Small farms • Lack of shade trees • Small farmers rely on streams for water supply • Low nutritional value of pastures (for cattle) • Overstocking of small-scale livestock (poultry) • Lack of veterinary services outside Efate and Espiritu Santo 	<ul style="list-style-type: none"> • Traditional multi-cropping methods • Increasing the number of small farm plots (involvement of rural dwellers) • Sustainable and affordable management practices for traditional crop production • Veterinary services available on Efate and Espiritu Santo • Grazing of cattle under coconut plantations

5. Stakeholder Consultation Relating to Climate and Agriculture

5.1 VMGD consultation

The VMGD regularly interacts with the agricultural sector through their 3-monthly climate stakeholder engagement and annual national climate outlook forum (NCOF). VMGD also conducts joint engagement with the agricultural sector through the development of the Vanuatu Framework for Climate Services, the Vanuatu Coastal Inundation Project and most recently through the Van-KIRAP project. The outcomes of these interactions are incorporated into this document.

²³ Government of Vanuatu 2012; Vanuatu National Climate Change Adaptation Strategy 2012-2022

5.2 Vanuatu Coastal Adaptation Project²⁴

The Vanuatu Coastal Adaptation Project (VCAP), is a UNDP supported, GEF-LDCF led project working to build resilience and improve the quality of life in targeted vulnerable areas in the coastal zone via increased food production, improved infrastructure and sustained livelihoods. The project undertook stakeholder engagement with the Agricultural sector and produced a table describing the weather and climate information that could help manage climatic impacts on agricultural production and food security.

5.3 Van-KIRAP sector consultation

From January to December 2018, several workshops and consultations were held with the Van-KIRAP team and the Agricultural sector in which recommendations, actions and communication plans were developed and refined. The summary section below articulates the outcomes.

5.3.1 Van-KIRAP Inception Workshop – January 2018²⁵

The Technical Inception Workshop for Van-KIRAP funded by the Green Climate Fund (GCF) was held on 22 February 2018 at the Holiday Inn in Port Vila. Its purpose was to officially launch and commence the project, refresh awareness of the stakeholders about the project, and review project activities, and implementation arrangements.²⁶

One of the outcomes of the workshop was to identify the key project priorities for each sector. The priorities identified by Agriculture are listed below:

- Develop specific policy objectives on climate change resilience.
- Institutional Strengthening Project for the Department of Agriculture and Rural Development (ISP for DARD), focussing on the Risk and Resilience Unit, project management capacity and the food security and agriculture cluster.
- Review and implement organisational structure to effectively and efficiently implement objectives of the sector.
- Develop and strengthen adaptive and mitigation strategies and methods, monitoring and evaluation and protocols in agricultural development initiatives to effectively administer the sector.
- Enhance widespread coverage of agromet information:
 - Production and distribution of climate and agriculture info through promotion of the use of e-audio visual and print media.
 - Establish agricultural info database and document Information Knowledge Management (IKM).
 - Develop an information gathering and communication strategy, e.g. community climate and agriculture information call centres (pest and diseases, market access, etc.).
 - Improve mobility of agriculture extension officers/services by provision of assets, inputs, relevant infrastructure to adopt climate and agriculture info (planting materials, info, etc.).
 - Build risk reduction capacity of farming communities through training and awareness

²⁴ GEF, Vanuatu Coastal Adaptation Project: Climate Information and Services, Summary Sector tables, 2017

²⁵ SPREP, Inception Report: Climate Information Services for Resilient Development Planning in Vanuatu (Van-CIS-RDP), 2018

²⁶ SPREP, Inception Report: Climate Information Services for Resilient Development Planning in Vanuatu (Van-CIS-RDP), 2018

- Maintain climate risk info decision support tools using GIS:
 - Promotion of improved technologies for food crop production and resilience to climate change.
- Department of Agriculture and Rural Department activities are centred around the 3 pillars of the National Sustainable Development Plan – economic, social and environmental.
- Promoting one pillar and ignoring the rest will not achieve sustainable development.
- Genetic material and local crops – need to assess which crops grow better in the communities and under future climate change, which genetic crop will grow under various projections and focus on developing these.

5.3.2 Van-KIRAP Sector Workshops – October 2018

VMGD, with funding support from the GCFSPREP, organised a Sector Consultation Workshop for Developing Climate Action and Communication Plans from 23 October to 2 November 2018.²⁷ Pacific Science Solutions (PSS) facilitated and led the consultations with the workshop participants.

The workshop was structured in three parts: the first part was held in Port Vila and attended by the Project Delivery Partners, sectors and other science organisations. Sector representatives were supported to draft Action and Communication Plans relating to their use of climate information. The second part of the workshop was held in Santo where provincial sector representatives were asked to review the draft sector action and communication plans written by their Port Vila colleagues. The last part of the workshop was held in Port Vila, where senior sector representatives reviewed and finalised their draft action and communication plans.

See the Workshop Report for more information.

5.3.3 Van-KIRAP Follow-up Sector Consultation – December 2018

From 3–7 December, Pacific Science Solutions and SPREP conducted follow-up consultations with representatives from four sectors (agriculture, tourism, fisheries and water) to discuss their draft sector plans and seek their respective Directors' preliminary endorsements. The draft plans incorporated the outcomes of the consultation workshops (Section 5.3.2). Infrastructure noted that they were satisfied with their draft plan therefore no meetings were scheduled with Public Works Department (PWD). Further changes and inputs were provided during the follow-up meetings which have been incorporated in this document.

6. Summary of Outcomes for Agriculture

The following information comes directly from the policy review and the consultations with VMGD and the Ministry of Agriculture and Rural Development, Livestock and Biosecurity. The tables outline the proposed recommendations for the agricultural sector's use of climate services. The proposed actions should be undertaken in conjunction with a communication plan to ensure effective communication between the agricultural sector, its primary stakeholders and VMGD.

²⁷ SPREP, Van-KIRAP Sector Consultation Workshop Report, 2018

6.1 Recommendations

The recommendations from the VFCS and priorities identified at the Van-KIRAP Inception workshop were reviewed, updated, revised and prioritised by staff from DARD and Biosecurity at the Van-KIRAP Sector Consultation workshops. Participants added information and clarity to the recommendations.

Table 2: The final list of the Recommendations

RANK	LEAD GFCS PILLAR	RECOMMENDATION
1	Research, Modeling and Prediction	Undertake research: Establish relationships between climate thresholds and crop and animal responses
2	Observations and Monitoring	Establish monitoring of climate related impact data
3	Observations and Monitoring	Extend climate variable observations (soil moisture/salinity). Need soil analysis for each site (on farm trials)
4	Observations and Monitoring	Establish agricultural information database and data digitisation
5	User Interface	Develop communication strategy
6	Climate Services Information System	Incorporate traditional knowledge into Agriculture sector
7	Climate Services Information System	Develop special bulletin for agrometeorology (use of audio-visual products and print media)
8	Capacity Building	Provide training and awareness for farmers on climate information
9	Capacity Building	Increase mobility of agriculture extension officers/services. Need for other sites throughout the country
10	Capacity Building	Provide train the trainers program for agromet staff. Train the trainers/staff increasing capacity in research

6.2 Alignment of recommendations with National and Regional policies and plans

The top 5 national and regional policies associated with Agriculture and Climate were reviewed and assessed for alignment with the recommendations. The outcome of this review is listed below. The documents reviewed were: Vanuatu Agriculture Sector Policy (VASP) 2014-2023; National Sustainable Development Plan (NSDP); Vanuatu Framework for Climate Services (VFCS); and VMGD Strategic Development Plan (VMGD SDP); Pacific Roadmap for Strengthened Climate Services (PRSCS); and Republic of Vanuatu Second National Communication to the UNFCC (SNC).

Table 3: Recommendations aligned with National and Regional policies and plans

RANK	RECOMMENDATION	POLICY & PLAN ALIGNMENT
1	Undertake research: Establish relationships between climate thresholds and crop and animal responses.	<p>VASP 2014-2023: Under the Specify Policy Directives & Strategies No 6; it addresses the research and development requirements whereby all research activities undertaken in the agriculture sector in Vanuatu should be linked into development programs in agriculture. While the government prioritizes the introduction of climate and risk resilient crops for cultivations by farmers, all stakeholders must ensure that Vanuatu does not lose those crops that are endemically suited to the environments of the country</p> <p>NSDP 2016-2030: Environment Goals & Policy Objectives: ENV 5.6 "Enhance environmental monitoring, evaluation and research with relevant, open and transparent data sharing among relevant agencies"</p> <p>VFCS: The agriculture sector has been identified as one of the sample research needs that will improve the climate services. (pg. 37-38): stakeholders expressed interest in sub-seasonal forecasting and associated applications in Vanuatu, e.g. for agricultural crop planning. In particular it notes that there is a need for more sector-specific research on the effects of weather and climate on crops, animals, diseases, pests, etc., further noting that this should be done through detailed modelling studies (e.g. using crop models, investigating specific thresholds that are important for crop development etc.), and could lead to the production of hazard and/or suitability maps.</p> <p>VMGD SDP 2013-2023: VMGD targets to achieve its Mission through excelling in many of its operational areas including "Research and innovation targeting improved products and services to all stakeholders". One of the key outcomes for Climate Division is to develop its research capacity and priorities.</p>
2	Establish monitoring of climate related impact data	<p>NSDP 2016-2030: Environment Goals & Policy Objectives: ENV 3.2 "Improve monitoring and early warning systems"; ENV 5.6 "Enhance environmental monitoring, evaluation and research with relevant, open and transparent data sharing among relevant agencies".</p> <p>VFCS: The Framework sees the importance of the developing climate services by having reliable climate data which includes historic and real-time observations of climate variables, plus computer models covering both historic and future periods. (pg. 12)</p> <p>VMGD SDP 2013-2023: Key Outcome 1. for the Climate Division states "Improved management of historical meteorological, hydrological and other related environmental data".</p> <p>PRSCS: Recommends the use of agricultural extension officers as a resource for collecting routine meteorological and other agricultural data.</p> <p>SNC: Specifically addresses the development/ procurement of designed electronic hardware and software for GHG inventory related work including a systematic research, monitoring and information collection system for GHG related data/information.</p>
3	Extend climate variable observations (soil moisture/salinity). Need soil analysis for each site (on farm trials)	<p>VASP 2014-2023: Policies Directives & Strategies: No 6.6.1 "Promote soil testing and analysis in all research initiatives"; 6.6.2 "Build capacity to undertake soil testing and analysis".</p>
4	Establish agricultural information database and data digitisation.	<p>VASP 2014-2023: Addresses the establishment of agriculture information database and document knowledge management on best practices.</p> <p>NSDP 2016-2030: Environment Goals & Policy Objectives: ENV 5.6 "Enhance environmental monitoring, evaluation and research with relevant, open and transparent data sharing among relevant agencies".</p> <p>VMGD SDP: The plan focuses on the maintaining and operational of the Climate database such as CliDE.</p> <p>SNC: Under the objective 5.6 highlights Gaps in Climate Change Policy and Information, focus on creating easy access to climate change information and make this information available in local languages.</p>
5	Develop communication strategy	<p>VASP 2014-2023: Specific objectives 2.3.4 "Develop information gathering and communications strategies e.g. Call Centres, SMS".</p> <p>NSDP 2016-2030: ECO 2.9 Increase use of and access to information and communications technologies, including on-line government services.</p> <p>VFCS: The Framework recommends VMGD should have a Communication strategy to formalise the use of the existing networks in the exchange of climate and impact data and information and strengthening the two-way communication.</p> <p>VMGD SDP: Key Outcome 8 under the Outreach and Communications Internal Working Group, states "Devise an Outreach and Communication Strategy including a timeline for implementation".</p>

RANK	RECOMMENDATION	POLICY & PLAN ALIGNMENT
6	Incorporate traditional knowledge into Agriculture sector	VASP 2014-2023: Specific objectives No 6.8: focus on incorporating custom and traditional knowledge in agriculture research. "Document traditional agricultural knowledge and validate results for adoption".
		NSDP 2016-2030: Society Goals & Policy Objectives: SOC1.2 "Preserve and enhance cultural and traditional knowledge, including appropriate medicines, natural remedies and healing"; SOC1.7 "Safeguard the traditional economy as a valued means of contributing to the wellbeing of the population and complementing the formal economy". Environment Goals & Policy Objectives ENV 1.5 "Enhance traditional agricultural practices, focusing on disaster risk reduction and climate change adaptation practices".
		VFCS: The Framework identifies traditional knowledge (TK) as an area that needs more research on links of climate service. In January 2013 -June 2016 a project was developed with an aim of documenting current methods of traditional knowledge use for weather and climate forecasting, and integrate these with modern scientific methods, in order to improve decision making at the community level.
		VMGD SDP 2014-2023: Includes the capture of traditional knowledge and development of new indicators when needed.
		SNC: An Australian funded program was established to facilitate 20 civil society organizations in sharing of lessons and good practice approaches for the Vanuatu Climate Action Network (VCAN). The program works with communities in nine islands across four provinces. It takes a broad view of resilience as the ability of women, men and children to realise their rights and improve their wellbeing despite shocks, stresses, and uncertainty. Community members are supported to plan and implement activities to strengthen DRR, Water, Sanitation and Hygiene (WASH), Natural Resource Management (NRM), agriculture, nutrition, traditional knowledge, women's leadership and education.
		PRSCS: Actions for establishing a National Climate Information Services system includes incorporating Traditional Knowledge, practices and language in the information / impact forecasts.
7	Develop special bulletin for agrometeorology (use of audio-visual products and print media)	VASP 2014-2023: Policy Directives & Strategies No 2.3 focuses on educating and informing the public on relevant agriculture developments through the use of electronic audio visual and print media (Objective 2.3.1) and provide adequate funding for production and dissemination of information.
		VFCS: An Agriculture News Bulletin is produced quarterly, and often includes information on the seasonal climate outlook. One of the recommendations in the Framework is "The Vanuatu Monthly Climate Summary (VMCS) bulletin should be enhanced to make more use of observed climate information and products and include impact assessments.
		VMGD SDP: Key outcome 6 addresses established and routinely improving the agrometeorology services;
		PRSCS: Actions for establishing a National Climate Information Services system includes regular bulletins.
8	Provide training and awareness for farmers on climate information	VASP 2014-2023: Policy Directives & Strategies No 2.1.1 "Develop appropriate agriculture training syllabus and modules based on the needs of the sector (VQA, Education".
		NSDP 2016-2030: ENV 3.1 "Institutionalize climate change and disaster risk governance and build institutional capacity and awareness"; ENV 4.7 "Build capacity and support local communities to manage natural resources".
		VFCS: Under the Framework list of recommendation No 15 looks at partnering with Pacific International Training Desk (PITD) on the potential of developing training courses for the provision and interpretation of climate information.
		PRSCS: Highlights the importance of capacity building and training programs on the use of climate products and services.
9	Increase mobility of agriculture extension officers/services. Need for other sites throughout the country	VASP 2014-2023: The objective No 2.4 looks at adopting more effective and innovating approaches to the extension services.
		PRSCS: Recommends the use of agricultural extension officers as a resource for collecting routine meteorological and other agricultural data.
10	Provide train the trainers program for agromet staff. Train the trainers/staff increasing capacity in research	VASP 2014-2023: Objective No 2.2 addresses training whereby adequate funding is provided.
		NSDP 2016-2030: ENV 3.4 Promote and ensure strengthened resilience and adaptive capacity to climate related, natural and man-made hazards
		PRSCS: Increase the capacity of agrometeorology personnel

6.3 Policies relating to agriculture and climate

Several national and sectoral policies, strategies, framework and plans support the need for the development and application of tailored climate information in the agriculture sector. This section outlines the references to climate and infrastructure in these documents and in related stakeholder engagement platforms. The Global Framework for Climate Information Services is also referenced. The review focusses on the integration of climate information services into agriculture: the findings of the review are provided in the Summary section below. *(Refer to Annexes for specific references from the documents below, on the provision and integration of climate information in the agricultural and livestock sector.)*

6.3.1 Vanuatu Agricultural Sector Policy (VASP) 2014–2023

The Vanuatu Agricultural Sector Policy outlines the sustainable development pathway for the agriculture sector in Vanuatu acknowledging the vital importance the sector plays both as a primary sector and in support of other essential sectors like tourism and construction.

The Agriculture Sector Policy, underpinned by social, economic, ecological and cultural principles and sustainable development pillars, is organised around 13 thematic areas. Two thematic areas, namely Research and Development, and Production and Market Access, support all the sustainable development pillars. The social pillar is directly addressed in the thematic areas of Institutional Setup, Capacity Building, and Gender and Vulnerable Groups. The issues of economic development are covered in the thematic areas of Finance, Investment and Employment, and Market Access. The thematic areas which contain environmental issues include Land Use, Planting Materials, Environmental Protection and Sustainable Farming and Climate Variability, Climate Change and Disaster Risk Management.²⁸

The policy specifically acknowledges climate variability, climate change and disaster risk reduction (DRR) as a core theme. It strongly supports mainstreaming of climate variability, change and DRR into all development projects. It allocated a Food Security and Agriculture Cluster with provincial focal points to monitor programs and issues relating to climate change and natural disasters. It promotes training and awareness of climate information, climate impact data and the use of climate resilient crops (and by extension the need for research into climate resilient crops.) It specifically acknowledges that "there is still a severe deficit in climate knowledge, information, technology and implementation for vulnerable farmers"²⁹

²⁸ Government of the Republic of Vanuatu, Vanuatu Agriculture Sector Policy, 2014

²⁹ Government of the Republic of Vanuatu, Vanuatu Agriculture Sector Policy, 2014

6.3.2 Vanuatu Meteorology and Geohazards Department Strategic Development Plan (VMGD SDP) 2014-2023

The VMGD SDP “sets the strategic context and direction for strengthening the capacity of the VMGD, with emphasis on developing and supporting “...state of the art technical services...” collectively through enhanced capacity, coordination and partnerships. The Strategy focuses on the following priorities (amongst others):

- Improved weather, climate and climate change services (including across multiple hazards, stakeholders and time frames),
- Improved observations and associated monitoring networks, and
- Enhanced capacity for both administrative/project management and research and development, outreach and communications.

The Strategy summarises the current situation (capacity, activities, products and services) for the relevant Divisions of the VMGD including Weather Forecasting and Services, Climate, Climate Change and Disaster Risk Reduction, Observations, and Information Communication Technology and Engineering.³⁰

The VMGD SDP under the Climate Division section has a specific key outcome (number 6) relating to agrometeorology. This key outcome 6 states the importance of developing a national agrometeorology program and the requirement for VMGD to assist the agricultural sector and farmers to integrate and use climate information, forecast services and warnings in their operations.

6.3.3 Vanuatu National Climate Change Adaptation Strategy (NCCAS)

The National Climate Change Adaptation Strategy (NCCAS) is designed to guide the implementation of efficient and effective activities to manage climate change impacts on the land-based resource sectors in Vanuatu. The NCCAS sets out a systematic, long-term approach for embedding climate change adaptation into core sectoral functional activities. Sector specific action plans detail substantive interventions to address adaptation needs and specify the allocation of responsibilities and definitive implementation timelines.³¹

The NCCAS focuses on building capacity in land-based resources sectors including agriculture to cope with the current and anticipated impacts of climate change. Based on the IPCC predictions, changes in rainfall and tropical cyclone intensity will result in significant damage to food crops, with rural and inland settlements more likely to be adversely affected.

6.3.4 Climate Change and Agriculture in Vanuatu: A study of Crops and Farming Systems

The FAO funded document Climate Change and Agriculture in Vanuatu: A study of Crops and Farming Systems “[a] study emanating from a project targeting select communities most susceptible to

³⁰ SPREP, GCF Funding Proposal: Climate Information Services for Resilient Development in Vanuatu, 2016

³¹ Government of the Republic of Vanuatu, National Climate Change Adaptation Strategy for Land Based Resources 2012 - 2022, 2011

climate-change and natural disasters, to quantify their degree of susceptibility and capacity to respond to them. The project considers the capacity of vulnerable communities to produce food under the following scenarios: flood, rising sea level, cyclone, volcanic eruption, drought (shortage of water) and tsunami. The document includes recommended strategies for farmers to use as a tool to address adverse impacts of climate change and natural disasters.³²

The study makes general recommendations that the Government must provide awareness on climate change and its impacts across a full range of stakeholders and that climate change-agriculture interactions must be included in agricultural programs. It notes that valid and comprehensive agricultural data must be collected, analysed and used to enable climate-smart strategies and policies. It calls for research on climate change and agriculture and climate tolerant crops as a high priority. Lastly it notes the importance of VMGD to improve and strengthen their national climate forecasts and their partnership with agriculture to improve and strengthen awareness of the use of climate forecast information.

6.3.5 National Sustainable Development Plan (NSDP) 2016-2030

The National Sustainable Development Plan “charts the vision and overarching policy framework for achieving a stable, sustainable and prosperous Vanuatu within the next fifteen years. It sets out the national priorities and context for the implementation of the Sustainable Development goals over the same period.³³ Vanuatu’s development priorities are classed under the three pillars of society, environment and economy.

The SDP has under its environmental goals and policy objectives Pillar ENV3: Climate and Disaster Resilience. The objectives listed here propose improving monitoring and early warning systems, as well as the promotion of resilience and adaptive capacity to climate related hazards.

6.3.6 Republic of Vanuatu National Climate Change and DRR Policy 2016-2030

The Republic of Vanuatu National Climate Change and DRR Policy “provides the overall vision, principles, strategic goals, priorities and strategies for climate change and disaster risk reduction. Vanuatu’s strategic goal for climate change and disaster risk reduction is resilient development.

Strategic priorities are categorised under systems and themes. Systems include governance, finance, and knowledge and information. Strategic priorities that are categorised as themes include climate change adaptation and disaster risk reduction, low carbon development, and response and recovery.³⁴

32 Humanitarian Response < <https://www.humanitarianresponse.info/en/operations/vanuatu/document/climate-change-and-agriculture-vanuatu-study-crops-and-farming-systems>>

33 Government of the Republic of Vanuatu, Vanuatu 2030 The people’s plan: National Sustainable Development plan 2016 - 2030, 2015

34 World Meteorological Organization (WMO), Enhancing Early Warning Systems to build greater resilience to hydro and meteorological hazards in Pacific Small Island Developing States (SIDS): National Consultation Report, Jan 2018

The strategy notes that some of the projected consequences of climate change on agriculture are reduced availability of fresh water, shifts in crop seasonality of harvest, planting and fruiting; more pests and diseases of animals, crops and trees; and compromised food security.

6.3.7 Vanuatu National Adaptation Programme of Action (NAPA)

Vanuatu's NAPA "outlines the most urgent and immediate needs with respect to climate change and identified several priority sectors (Agriculture/Food Security, Coastal Zones and Marine Ecosystems, Water Resources and Public Health) for action."³⁵

The NAPA had three adaptation strategies related to Agriculture. They were as follows: agriculture and food security (preservation/processing/marketing, modern and traditional practices, bartering); more resilient crop species including traditional varieties; and sustainable livestock farming and management. Part II of the NAPA outlined project concepts of which Agriculture and Food Security was number one. In this section it noted the increasing incidence of extreme events and climate change is adding to the stress on the sector and that there is little additional information on the effect these changes will have on the cash crops that are essential to livelihood. It goes on to describe the effects of increased temperatures, more frequent and prolonged dry conditions and increased variability of rainfall and projections under selected climate change scenarios.

Additionally, the NAPA notes the main climate issues and possible adaptation options in each province. The proposed adaptive strategies are based on the province. For example, in Tafea Province it is noted that crop planting and harvesting are strictly governed by customary tradition and though shifts in climate patterns are being observed people are reluctant to change agricultural practices accordingly. The proposed adaptation option is for more awareness to improve the understanding of communities on climate. This is quite different from Shefa Province where there will likely be declining crop production—the proposed adaptive strategy there is to develop improved crop varieties and implement diversification of crops.

6.3.8 Republic of Vanuatu Second National Communication to the UNFCC (SNC)

The Second National Communication (SNC) highlights Vanuatu's greenhouse inventory (GHG) as a baseline for the country to measure its progress towards reduction of greenhouse gases. The inventory for the base year 2000 and subsequent years 2005 and 2010 indicates that Vanuatu is a net sink for CO₂ emissions.

Vanuatu's SNC also generates and updates information about how projected climate change, climate variability and extreme events may affect Vanuatu's economic and social sectors as part of its vulnerability and adaptation assessment. Climate change and changing weather patterns are already having a negative impact on all the priority sectors – namely agricultural production, fisheries, human

³⁵ World Meteorological Organization, Enhancing Early Warning Systems to build greater resilience to hydro and meteorological hazards in Pacific Small Island Developing States (SIDS): National Consultation Report, Jan 2018

health, tourism and well-being. There is the indication that climatic change has consequences for decreasing national income and increasing key social and infrastructure costs.³⁶

The SNC notes that the numerous effects of climate change and variability—cyclones, flash floods, high rainfall, high temperature and long dry periods—will make agricultural production very challenging in Vanuatu. It remarks that climate change is likely to have a greater negative effect on the small farmers than on the larger commercial operators and that shifting cultivation is no longer possible due to soil degradation. It also points out the importance for Government to create an enabling environment for private sector led economic growth in the Agricultural sector.

The document highlights that the agriculture sector is the major contributor of methane emissions and the top contributor of greenhouse gases (GHG) in Vanuatu. The biggest contributors are livestock and N₂O emissions from agricultural soils. Vanuatu has a limited industrial sector and relatively poor energy infrastructure, which results in a high share of GHG emissions from the agriculture sector. The Department of Agriculture in Vanuatu needs both technical and financial support to come up with mitigation plans to reduce GHG emissions from the agriculture sector.³⁷

The SNC refers to the 2013 National Agriculture Position statement on Climate Change and Disaster Risk Reduction which “indicates that the adaptation priorities for new programs and projects on agriculture, climate change and disaster risk reduction should highlight and take into consideration the following priority solutions:

- introduction and improvement of climate resilient crops for cultivation by local farmers,
- preservation and improvement of local and endemic crops that hold climate resilience and environmental suitability,
- introduction and improvement of farming systems that enable adaptation or climate resilience,
- uptake, up scaling and dissemination of climate resilient crops and technologies,
- overcoming barriers to increased production and food security, and
- economic analysis and cost benefits of climate resilient agriculture.³⁸

6.3.9 Vanuatu Coastal Adaptation Project (VCAP)

The VCAP produced excellent information describing the weather and climate information that could help manage climatic impacts on agricultural production and food security. The tables outline what the risk is, what climate/weather triggers the risk, whom it effects, what the problem and impact is, and lastly what early warning information is required.

36 World Meteorological Organization, Enhancing Early Warning Systems to build greater resilience to hydro and meteorological hazards in Pacific Small Island Developing States (SIDS): National Consultation Report, Jan 2018

37 Government of the Republic of Vanuatu, Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2014

38 Government of the Republic of Vanuatu, Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2014

6.3.10 Vanuatu Framework for Climate Services (VFCS)

The VFCS is principally guided by the five pillars of the Global Framework for Climate Services, the VMGD Strategic Development Plan and by various national level stakeholder consultations. The stated goal of the VFCS is to “...ensure climate services for Vanuatu are of world-class standard, sustainable, are reaching all end-users, and are effectively helping people manage and adapt to climate variability and change in Vanuatu (SPREP 2016). This Framework identifies the most pressing needs as:

- The development, through key stakeholder consultation, of tailored climate products (including training on their use), and
- Improvements to and formalization of mechanisms for communicating and disseminating climate information.

The Framework makes 18 specific recommendations, based around the five pillars and associated structure of the GFCS, as priority actions. The VFCS aims to strengthen climate information development, provision, understanding and use throughout Vanuatu. It describes the following:

- Capacity of both providers and receivers (source and Next/End-Users) of climate services,
- The interface platforms and networks used for dissemination of climate information and its value,
- The kind of products that can be produced and tailored to user needs,
- The research gaps that still require filling, and
- The requirement for high quality climate observations fundamental to all services.”³⁹

The VFCS identifies the most pressing needs as tailored climate products and formalisation of mechanisms for communicating and disseminating climate information. It makes four recommendations for agriculture which are summarised as the need for a climate related impact database with monitoring information on agricultural and livestock productivity. More research is needed into the relationship between climate and crops, animal diseases, pests and invasive species. Identifying and mapping agro-climatic high-risk hot spots is vital, and the measurement of additional climate variables. A national drought policy is essential.

6.3.11. Pacific Roadmap for Strengthened Climate Services (PRSCS)

The Pacific Roadmap for Strengthened Climate Services prioritises key actions identified for implementing the GFCS that are relevant to the Pacific. “The Roadmap focuses on the needs of both climate service providers and the key sectors that rely on their information and advice to inform planning and decision-making. It provides a guiding framework for the development of national and regional climate services targeting the Pacific priority areas.”⁴⁰ Pacific Island Countries and Territories have adopted the five priority areas of GFCS and added a further two priorities: tourism, and fisheries and aquaculture.

³⁹ SPREP, Vanuatu Framework for Climate Services, 2016

⁴⁰ SPREP, Pacific Roadmap for Strengthened Climate Services, 2017

The PRSCS provides a regional overview of the agricultural sector in the region. It provides information on the typical studies/activities that climate services can support, such as: The responses of traditional crops, e.g. sweet potato, cassava, taro, banana, breadfruit and yam to existing environmental drivers (e.g. climate variability and extremes, soil and nutrient interactions)⁴¹; understanding the responses of island crops to enhanced CO₂; developing and enhancing the capacity to model crop and cropping systems; estimating appropriate stocking rates for those areas involved in commercial animal husbandry ; identifying farming system adaptation strategies given the risk profiles associated with both climate variability and change; and examining the economic value of specific operational seasonal climate forecasts in supporting agronomic management decisions for the production of Pacific staple food crops, e.g. assessing the risk of shortages in specific food crops.

The document also discusses climatological data for agriculture as well as agricultural data and examples of agricultural projects across the Pacific. It should be noted that the SPC/GIZ crop calendars were featured in the Roadmap as examples of excellence in agriculture. The section ends with some recommended actions which can be undertaken under the GFCS pillars to enhance Climate Information Services for agrometeorology.

Table 4: Recommended Actions for Agricultural sector in PRSCS

NUMBER	LEAD GFCS PILLAR	ACTION	NATIONAL ACTIVITY / REGIONAL ACTIVITY
1	User Interface	With agriculture advisers/extension officers, develop drought management plans for different subsistence and cash crops	National
3	Climate Services Information System	Prepare agrometeorological advisories, crop calendars, crop models, seasonal outlooks for crop yield forecasts	Regional and National
4	Climate Services Information System	Provide drought, irrigation and seasonal climate advisories to assist farmers	National
5	Observations and Monitoring	Explore the use of agricultural extension officers as a resource for collecting routine meteorological and other agricultural data.	National
7	Research, Modeling and Prediction	Explore the impacts of climate change and changing seasonality on agriculture (e.g. salt-water intrusion etc)	Regional and National
8	Capacity Building	Increase the capacity of agrometeorology personnel	Regional and National

41 Pacific Root Crops: <http://www.fao.org/docrep/013/am014e/am014e04.pdf>

6.3.10 Global Framework for Climate Services (GFCS)⁴²

The Global Framework for Climate Services (GFCS), formed as the principal outcome of the 2009 World Climate Conference 3. The GFCS provides a worldwide mechanism for coordinated actions to enhance the quality, quantity and application of climate services. The five priority areas under GFCS are: Agriculture and Food Security; Disaster Risk Reduction; Energy; Health; and Water. The Framework is built through user–provider partnerships that include all stakeholders.

The GFCS is built upon the following five components, or pillars (see Figure 5 below):

- i. **User Interface Platform (UIP):** a structured means for users, climate researchers and climate information providers to interact at all levels;
- ii. **Climate Services Information System (CSIS):** the mechanism through which information about climate (past, present and future) is routinely collected, stored and processed to generate products and services that inform often complex decision-making across a wide range of climate-sensitive activities and enterprises;
- iii. **Observations and Monitoring (O&M):** to ensure that climate observations and other data necessary to meet the needs of end-users are collected, managed and disseminated and are supported by relevant metadata;
- iv. **Research, Modelling and Prediction (RMP):** to foster research towards continually improving the scientific quality of climate information, providing an evidence base for the impacts of climate change and variability and for the cost-effectiveness of using climate information;
- v. **Capacity Development (CD):** to address the particular capacity development requirements identified in the other pillars and, more broadly, the basic requirements for enabling any Framework-related activities to occur.⁴³

⁴² <http://www.wmo.int/gfcs/>

⁴³ WMO, A step-by-step guide for establishing a national framework for climate services, 2017

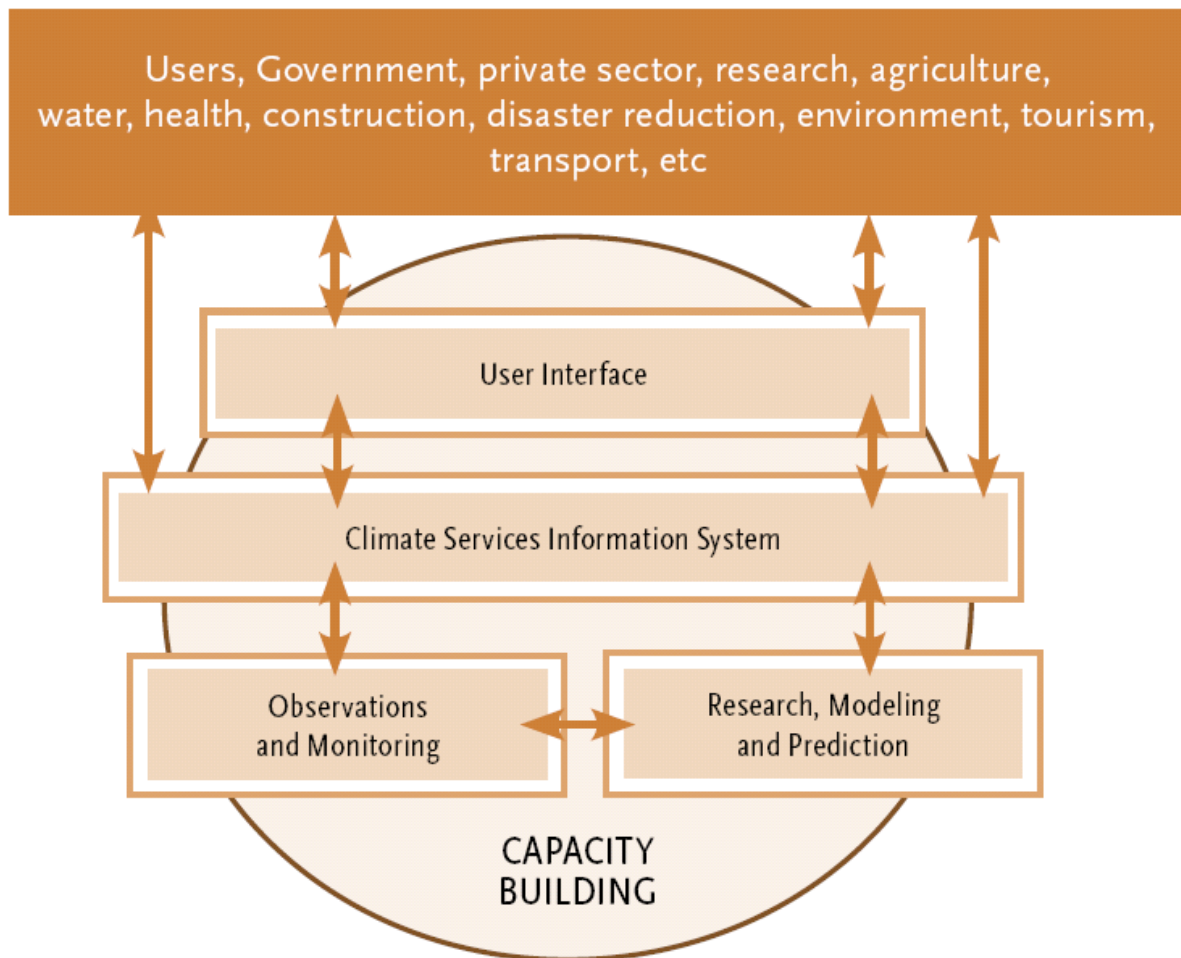


Figure 4: A schematic depicting the functional components of the GFCS (Source: WMO)

The primary focus of the GFCS is to enable better access and use of climate information by users.

6.4 Climate Information Services (CIS) Action Plan

Based on the final recommendations (Section 6.1), the CIS Action Plan and the Communication Plan were developed by officers from DARD and Livestock at the Van-KIRAP Sector Consultation workshops. The participants identified short-term, mid-term and long-term actions and sub-actions for each recommendation: short-term for periods of up to 6 months, mid-term ranging from 6 months to 2 years, and long-term ranging from 2 to 4 years. Required resources and budget implications are included but they will need to be revised and the actual cost estimated through further consultations amongst the key stakeholders. The following table outlines high level actions and sub-actions: a detailed workplan with costing and timeline will be agreed before the implementation of each recommendation. A Monitoring and Evaluation Plan will help to ensure successful implementation of the actions.

The key objectives of the Action Plan are:

1. To ensure the Ministry of Agriculture and Rural Development, Livestock and Biosecurity personnel and farmers are aware and understand climate information and products; and
2. To enable them to readily access and effectively use this climate information for planning and decision-making at local and national levels.

Table 5: The Action Plan for Agriculture and Livestock sector

Rank	Recommendation	Proposed Action	Proposed Sub- Action	Timing (ST,MT,LT)	Responsible Parties	Resources Required	Budget Implication	Assumption/Comments
1	Undertake research: Establish relationships between climate thresholds and crop and animal responses.	Conduct field trials to collect data	Identify locations for field trial	LT	Researcher (VARTC, Plant health/protection officer, Extension officers (Agriculture & Livestock) / Area secretary/Lead Farmer /NGOs/VMGD	Staffing, AWSs, equipment (computer), communication	Each day/month additional person to collect crop & animal data	Possible funding from Van-KIRAP Activities 4.4.1, 5.5.1 and 5.8.1
			Installation of automated weather station at research site				Funding for student trainees & USP students to enter data	
		Establish research program in partnership with VMGD	Draft research proposal in partnership with VMGD				Funding for new AWSs and equipment	
			Undertake literature review				Funding for training and travel cost, DSA for students	
			Develop or customise a mobile App for agromet data collection					
			Conduct data analysis					
		Conduct research on implication of climate change on crops over the next 10, 20 & 30 years	Projection of crop yield based on different climate change scenarios	LT	DARD, VMGD, BoM, CSIRO, APCC	Staffing, communication, equipment, climate/crop model	Funding for research (technical expertise, model development etc), travel, DSA	
			Develop climate change simulation model for crops					
2	Establish monitoring of climate related impact data	Identify hot spots	Identify climate related impacts on agriculture	MT, LT	DARD extension officer/ area secretary/ Lead Farmer/NGOs/VMGD	Staffing, communication, subject matter expertise	Funding for training on data collection. Funding for subject matter expertise including development of methodology/templates may be required.	Possible funding from Van-KIRAP Activities 2.2.1, 4.1.1 and 5.8.1.
		Documentation of impact data	Develop data collection methodology and templates					
3	Extend climate variable observations (soil moisture/salinity). Need soil analysis for each site (on farm trials)	Provision of equipment (soil moisture, salinity, temperature, PH etc..equipment)	Identify locations for observations	MT, LT	DARD extension officer/ area secretary/ Lead Farmer/NGOs/VMGD	Equipment (soil analysis equipment's & tools) , Staffing, communication	Funding for equipment, soil analysis for each sites, training, travel, DSA	Possible funding from Van-KIRAP Activities 3.5.1, 5.8.1 and 5.8.2). New observations will be managed/undertaken by the current DARD staff.
		Conduct soil analysis	Train the trainers (soil agronomist to analyse soil)					
4	Establish agricultural information database and data digitisation.	Procure or access appropriate database management system	Explore and determine an appropriate database management system (ie. DARD database) for agro-met data	MT, LT	DARD Communication officer/Plant health officer/ Part time database officer/NGOs	Equipment, staffing, communication	Funding for software license or one off cost may be required	Possible funding from Van-KIRAP Activities 3.5.2 and 4.1.1.
		Digitisation of the data	Update current database				Funding for equipment, transport, DSA	
			Establish auto ingestion or manual data entry system				Funding for training	
			Train the trainers (data management system)					
5	Develop communication strategy	Develop a communication strategy	Conduct a consultation with key stakeholders	ST	Director & senior managers,DARD extension officer/ area secretary/ Lead Farmer/NGOs/VMGD	Staffing, subject matter expertise, communication	Funding for technical expertise cost, travel, DSA	Completed through Van-KIRAP Activity 1.1.2.
			Develop a communication plan					

Rank	Recommendation	Proposed Action	Proposed Sub- Action	Timing (ST,MT,LT)	Responsible Parties	Resources Required	Budget Implication	Assumption/Comments
6	Incorporate traditional knowledge into Agriculture sector	Undertaken analysis to match agricultural events to documented traditional knowledge.		MT, LT	Researcher (VARTC, Plant health/protection officer, Extension officers (Agriculture & Livestock) / Area secretary/Lead Farmer /NGOs/VMGD	Staffing, subject matter expertise	Funding for training, technical expertise and information gathering	This proposed action can be built upon the outcomes of the COSPPac/SPREP TK project
		Develop crop calendars						
7	Develop special bulletin for agro-meteorology (use of audio visual products and print media)	Develop monthly Agro met bulletin	Confirm the content and the layout for the bulletin	MT, LT	VMGD, DARD, Extension officer, area secretary, lead farmers, CDC, NGOs	Staffing , equipment, communication	Funding for the training	Possible funding from Van-KIRAP Activity 5.8.1.
		Develop dissemination channels	Train the trainers on agro-met bulletin				Travel cost	
			Develop audio visual products				Communication cost	
			Develop print media				Funding or printing media/publications.	
			Utilise Facebook, text messages and radio					
			Utilise existing community networks (Chief, women and youths)					
			Work with VBTC to further disseminate Climate Information Services (CIS)					
8	Provide training and awareness for farmers on climate information	Conduct training on climate information	Develop training materials	MT, LT	DARD, VMGD, NGOs	Staffing , subject matter expertise, training equipment, communication	Funding for technical expertise	Possible funding from Van-KIRAP Activities 1.2.1, 5.8.1 and 5.8.2
			Conduct training workshops for farmers				Funding for workshops, travel, DSA	
		Raise awareness on climate information	Develop awareness materials and disseminate				Printing cost	
			Conduct awareness workshops in farming areas					
			Present at climate field schools					
9	Increase mobility of agriculture extension officers/services. Need for other sites throughout the country	Provide means of transport to extension officers/research officers	Purchase/procure quad bikes	LT	DARD/LD	Staffing, quad bikes	Funding for quad bikes and additional staff	Need clarification from GCF.
10	Provide train the trainers program for agro-met staff. Train the trainers/staff increasing capacity in research	Conduct training of technical (DARD, VARTC) and provincial staffs	Develop training material	ST, MT	DARD, VMGD, NGO's, LD	Staffing , subject matter expertise, training equipment, communication	Funding for technical expertise	Possible funding from Van-KIRAP Activities 1.2.2, 4.1.1 and 5.8.2
		Increase staff's capacity in research	Provide research equipment's (for plant/animal data collection)				Funding for workshops, travel, DSA	
			Establish partnership with relevant agro-met research centres				Funding for training equipment and materials	

6.5 Climate Information Services (CIS) Communication Plan

A communication plan is a policy-driven approach to providing stakeholders with information. The Plan formally defines **who** should be given specified (**what**) information, **when** that information should be delivered and what communication channels (**how**) will be used to deliver the information.⁴⁴ This section outlines the Communication Plan's objectives, the current status of the communication mechanism, and the content of the Plan. The Plan should be regularly reviewed and updated.

6.5.1 The Objectives of the Communication Plan for Ministry of Agriculture and Rural Development, Livestock and Biosecurity

- To ensure that Ministry of Agriculture and Rural Development, Livestock and Biosecurity personnel and farmers are receiving timely and relevant climate information and products for planning and decision-making at local and national levels.
- To ensure an effective and efficient channel for communication and information dissemination exists between VMDG and the agricultural and livestock sector, and within the agricultural and livestock sector.

6.5.2 Linking climate information and products to specific operations

The following table outlines the types of climate information required for specific operational or decision-making process within Agriculture and Livestock sector. This information feeds into the Communication Plan (Table 6).

Table 6: Climate Information required for Agriculture and Livestock operation and decision-making processes

Sector operation or decision making process	Information/Product/Tool	Responsible person
Soil erosion control	Early warning of heavy rainfall; seasonal forecast	Soil agronomist/ DARD extension officer
Crop production slumps	Daily data feed for model run (e.g. DSSAT MODEL)	Researcher/ DARD extension officer
Extreme weather and agricultural impacts	Seasonal forecast and time series data	DARD extension officer
Drought; dry conditions; crop withering management	Early warning of dry periods and drought; seasonal forecasts; time series data, Riskscape	DARD extension officer
Livestock species	ENSO Update	Animal Health personal /Animal production
Egg production		
Growth rate		
Drop (Poultry)		
Changes of feed availability and prices		
Mating seasons		
Spreading of disease		
Drop in milk production		
Decrease in carcass weight		

44 <https://whatis.techtarget.com/definition/communication-plan>

6.5.3 The current situation in the agriculture and livestock sector

- Close relationship exists between VMGD and the Department of Agriculture (in particular) and Livestock.
- The Vanuatu Climate Update and the Monthly Climate Summary are sent to all Agriculture and Livestock staff by email.
- DARD representatives regularly attend the VMGD Climate Briefings.
- An Agriculture News Bulletin is produced quarterly, and often includes information on the seasonal climate outlook.
- Special leaflets are published (e.g. on mulching techniques, agroforestry, etc.) which are specifically designed to help farmers during times of climatic stress (e.g. drought).
- Climate field schools are run in all the provinces and include training on modifying agricultural practices (including planting different crops and varieties) during drier- and wetter-than-normal conditions.
- The Departments of Agriculture and Livestock have well-established provincial and community-based networks that should be used for the dissemination of simplified, tailored climate information.

6.5.4 Table Description

Responsibility: Nominates or delegates the personnel or agency responsible for sending the identified information or products to the intended audience.

Audiences/Receiver: Personnel or parties who should receive the information or the products. The diagram below outlines the flow of climate information dissemination from VMGD to various personnel within the Agriculture and Livestock sector.

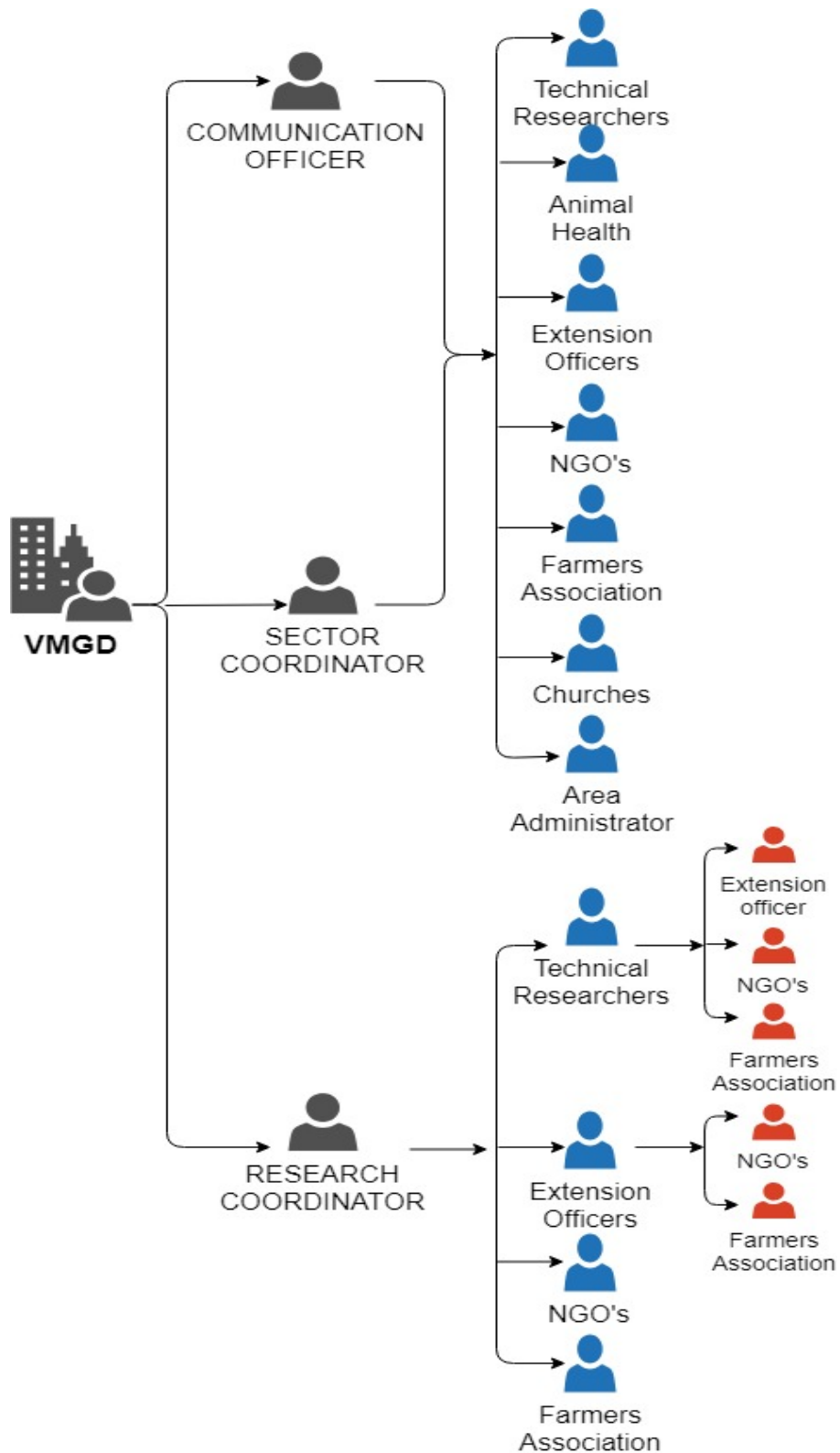


Figure 5: Climate information and products dissemination structure

Mode of Information Dissemination: Effective channels or communication medium that can be used to disseminate the information and the products. This may include: email, phone, Internet/webpage, social media (Facebooks), face, to face meetings, print etc.

Other Information: Describes the format (e.g. bulletin, brief summary, Excel etc.) and the most appropriate language (i.e. Bislama, English or French) for information or products.

Frequency and timing: frequency indicates how often the information is required or disseminated (i.e. weekly, fortnightly, monthly or annually). Timing indicates when in a defined period the information is required or made available (e.g. Vanuatu Climate Updates are available by the second week of each month).

Feedback Mechanism:

It is vital to measure results to understand whether objectives have been achieved. The regular evaluation process allows managers to make necessary adjustments during implementation in response to unexpected results and changed circumstances. Several feedback mechanisms are suggested for evaluating the effectiveness and the efficiency of the Communication Plan: regular surveys, feedback forms, follow up via phones, monthly reports, email, and face to face meetings. The timing and the mechanism for feedback can be mutually determined by the Responsible Party and the Audience. Feedback may be scheduled quarterly, six-monthly or yearly.

6.5.5 Updating the Communication Plan

During the life of Van-KIRAP, the Sector Coordinator will be responsible for:

- Initiating and scheduling feedback sessions with VMGD;
- Initiating and following-up on feedback sessions for other Responsible Parties, and providing feedback to VMGD;
- Negotiating changes and incorporating agreed changes in the Plan; and
- Circulating the Plan to all Responsible Parties and Audience after each update.

After the Van-KIRAP, it is recommended that this responsibility be taken up another relevant officer in DARD if the Sector Coordinator position no longer exist. This can be the Communication Officer.

Table 7: A detailed Communication Plan for Agriculture and Livestock Sector

Responsibility (sender)	Audience (receiver)	Type of Information/Product	Language	Format required	Mode of information dissemination	Frequency	Timing	Feedback Mechanism
VMGD	Communication Officer/Sector Coordinator/Research Coordinator	Early warning of heavy rainfall	English	Update Report	Website, FB, radio	As required		Feedback provided from monthly report
		Vanuatu climate update (VCU)	Bislama	Brief summary	Email, face to face, phone call, website, social media, proposed App, community boards (around Efate currently)	Monthly	2nd-3rd week of the month	Regular survey, feedback forms, follow up (extension officers/phone calls), email requested feedback
		Time series data (i.e. Soil variables, rainfall)	English	Excel spreadsheet	Email	As required		Email, face to face meeting, survey
		Drought advisory	English	Update Report	Email	Monthly	Second week of the month	Email, face to face meeting, survey
		ENSO Update	English and Bislama	Update Report	Email, face to face, phone call, website, social media, proposed App, community boards (around Efate currently)	Monthly	Second week of the month	Email, face to face meeting, survey
Communication officer/Sector Coordinator	Technical officers (Plant/Animal)	Climate related impact data	English, Bislama and French	Brief summary	Email, Facebook, phone call	Monthly, Quarterly	Beginning of the month	Extension officers/phone calls/messaging
	Animal Health personal /Animal production	ENSO Update	English and Bislama	Update Report	Email, face to face, phone call, website, social media, proposed App, community boards (around Efate currently)	Monthly	Second week of the month	Email, face to face meeting, survey
	Extension officers, farmers association, NGO's, Churches, area administrator	Agromet bulletin (use of e-audio visual and print media)	English and Bislama		Hand out, Facebook, email,	Monthly	Beginning of the week	Facebook , email , face to face
	Soil Agronomist	Update of soil variables, Early warning of heavy rainfall and VCU	English and Bislama	Update Report	Email and face to face	Monthly	Beginning of the week	Feedback provided from monthly report
Research coordinator	Technical researchers (VARTC), DARD, DOL	Daily data feed for model run (e.g. DSSAT MODEL)		Update Report	Email	Weekly	Beginning of the week	Face to face, reports, email
		Vanuatu climate update	Bislama	Brief summary	Email, face to face, phone call, website, social media, proposed App, community boards (around Efate currently)	Monthly	2nd-3rd week of the month	Regular survey, feedback forms, follow up (extension officers/phone calls), email requested feedback
		Update of soil variables	English and Bislama	Update Report	Email and face to face	Monthly	Beginning of the week	Feedback provided from monthly report
		Early warning of heavy rainfall	English	Update Report	Website, FB, radio	As required		Feedback provided from monthly report
	Extension officers	Vanuatu climate update (VCU)	Bislama	Brief summary	Email, face to face, phone call, website, social media, proposed App, community boards (around Efate currently)	Monthly	2nd-3rd week of the month	Regular survey, feedback forms, follow up (extension officers/phone calls), email requested feedback
Research coordinator/Extension officers	NGOs, Farmers Association	Vanuatu climate update (VCU)	Bislama	Brief summary	Email, face to face, phone call, website, social media, proposed App, community boards (around Efate currently)	Monthly	2nd-3rd week of the month	Regular survey, feedback forms, follow up (extension officers/phone calls), email requested feedback
		Time series data	English	Excel spreadsheet/update report	Face to face meeting	Monthly	Second week of the month	Email, face to face meeting, survey
		Drought advisory	English and Bislama	Brief summary	Face to face meeting	Monthly	Second week of the month	Email, face to face meeting, survey
Technical researchers (VARTC), DARD, DOL	Extension officers, NGOs, Farmers Association	Climate related impact data (when available)	English, Bislama and French	Brief summary	Email, Facebook, phone call	Monthly - Quarterly	Beginning of the month	Extension officers/phone calls/messaging

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8. Annexes

Vanuatu Agricultural Sector Policy 2014–2023

Priorities for Development Partners' Assistance:

No. 5. Any Development Partners funding allocated to agriculture development shall also include elements of climate change, crop adaptation to extreme/variable climate conditions and the strengthening of risk resilience.

Research and Development

No. 7. While the government prioritizes the introduction of climate and risk resilient crops for cultivation by farmers, all stakeholders must ensure that Vanuatu does not lose those crops that are endemically suited to the environments of the country.

Food Security and Agriculture Cluster

No. 16. That there will be a Food Security and Agriculture Cluster led by the Department of Agriculture and Rural Development, with provincial focal points, to coordinate and monitor programs and issues related to food security, climate change and natural disasters. ⁴⁵

Climate Variability, Climate Change & Disaster Risk Reduction

The specific objective under this theme is disaster and climate resilient agriculture, where the policy directives are as follows:

No. 12.1 Mainstream climate variability, climate change and disaster risk reduction using adaptation and mitigation strategies in all agriculture initiatives and developments

No. 12.1.1 All stakeholders consider climate variability, climate change and disaster risk reduction in all agricultural development initiatives (Farmers, Industries, NAB, VMGD, NDMO, DARD, NGOs, CSO, Development Partners, International Institutions, GoV Ministries)

No. 12.1.2 Consider climate variability, climate change and disaster risk reduction in all farming practices (Farmers, DARD, VARTC, NGOs, CSO, Development Partners, International Institutions)

No. 12.1.3 Build risk reduction capacity of farming communities through training and awareness to adapt and mitigate effects of climate variability, climate change and natural disasters (DARD, VMGD, NDMO, NGOs, CSO, Development Partners, International Institutions)

No. 12.1.4 Provide adequate funding for activities to address climate variability, climate change and disaster risk reduction (GoV, Development Partners, NGOs, CSO, International Institutions)

No. 12.1.5 Promote adaptive strategies in all agricultural development initiatives (Farmers, Industries, VMGD, NDMO, DARD, NGOs, CSO, Development Partners, International Institutions, GoV Ministries)

No. 12.1.6 Promote adaptive strategies in all farming practices (Farmers, DARD, VARTC, NGOs, CSO, Development Partners, International Institutions)

⁴⁵ Government of the Republic of Vanuatu, Vanuatu Agriculture Sector Policy, 2014

No. 12.1.7 Promote mitigation strategies in all development initiatives (Farmers, Industries, VMGD, NDMO, DARD, NGOs, CSO, Development Partners, International Institutions, GoV Ministries)

No. 12.1.9 Develop collaborative networks with national and international agencies to address climate change, climate variability and disaster risks (all stakeholders)

No. 12.1.11 Strengthen traditional and self-reliant agricultural systems through development and implementation of programs with components that encourage growing traditional climate-resilient staple crops such as sweet potato, taro, banana, yam, cassava and trees and animals (all stakeholders)

No. 12.1.13 Facilitate and coordinate research to develop stress-tolerant crop varieties, introduce new crops, and manage pests for climate change adaptation (GoV, VARTC, international agencies)

No. 12.1.14 Trial novel community extension models which enhance climate adaptation adoption, at the same time as decentralizing technology development and enabling service delivery by non-government and civil society stakeholders (GoV, civil society)

No. 12.1.15 Design and maintain a climate risk-informed decision support system using geographic information system (GIS) to optimize the planning and design of crucial agricultural adaptation investment projects (GoV, VMGD, international agencies)

No. 12.1.16 Direct diversification efforts towards reducing reliance on climate-sensitive farming practices and crops in high-risk areas and towards fast yielding high value crops to give farmers more fungible assets for adaptation (GoV, private sector, civil society, international agencies)

No. 12.1.17 Monitor, evaluate and report on climate change, climate variability and disaster risk reduction agricultural issues, initiatives and outcomes in accordance with the National Climate Change & Disaster Risk Reduction Policy and the National Sustainable Development Plan (all stakeholders).⁴⁶

*Challenges*⁴⁷

- Out of the total number of tropical storms affecting Vanuatu over the last 49 years, 36% contained hurricane force winds, 23% storm force wind and 20% gale force winds. The probability of being struck by hurricane force winds every year is very high for Vanuatu. Storm damage to crops and critical infrastructure requires strong collaboration among stakeholders involved in the area of disaster risk management and reduction.
- Prolonged (and or shortened) wet seasons produce conditions favourable for pests and diseases harmful to plant production and crop harvesting and become the causes of concern for food security and Vanuatu's socio-economic wellbeing. In the same manner, prolonged dry seasons are causing plant stress leading to reduced production. Traditional adaptation capacity is high, although traditional knowledge and risk reduction practices are generally being lost.
- Changing climatic conditions and natural hazards have implications for the transportation of agricultural produce from rural areas to markets in the main urban centres (e.g. poor road conditions, deteriorating wharfs and jetties and inconsistent shipping routes).

⁴⁶ Government of the Republic of Vanuatu, Vanuatu Agriculture Sector Policy, 2014

⁴⁷ Government of the Republic of Vanuatu, Vanuatu Agriculture Sector Policy, 2014

- Vanuatu's inability to increase and sustain agricultural production is exacerbated by the negative effects of climate change and climate variability. With temperatures increasing, seasonal rainfall patterns shifting, and extreme events more frequent and severe, the incidence of heat, water, pest/disease and soil fertility stress are drastically hampering already risk-prone production. While agricultural climate adaptation programs are now widespread (through SPC, GIZ, the World Bank and others) there is still a severe deficit in climate knowledge, information, technology and implementation for vulnerable farmers.⁴⁸

Vanuatu Meteorology and Geohazards Division Strategic Development Plan: 2014-2023

Of particular importance under the Climate Division are the following Key Outcomes (KO), Strategic Outputs (SO) and Key Performance Indicators (KPI):

- KO 1. Improved management of historical meteorological, hydrological and other related environmental data.
 - SO 1.1 The Climate Division is routinely digitizing historical data for weather, climate, agrometeorology, and CBRN stations and has all paper-based records archived and stored according to the VMGD data management and quality policy, including archival of data in back-up sites.
 - KPI-CS01: Historical meteorological, hydrological, agrometeorological and other related environmental datasets from synoptic weather stations are preserved.
 - KPI-CS02: Historical meteorological, hydrological, agrometeorological and other related environmental datasets from climate stations are preserved.
 - KPI-CS03: Historical meteorological, hydrological, agrometeorological and other related environmental datasets for agrometeorological stations are preserved.
 - KPI-CS01: Historical meteorological, hydrological, agrometeorological and other related environmental datasets for the CBRN gauges' sites are preserved.
- KO 4. Monthly to seasonal climate information, forecasts, services and warnings are continually developed and routinely improved.
 - SO 4.1 An established set of quality management standard manuals is developed and produced for reference for climate services development and engagement with end users including capture of traditional knowledge and development of new indicators where needed.
 - KPI-CS14: Monthly to Seasonal climate information, forecast services and warnings for Vanuatu developed and produced.
 - KPI-CS15: Mechanism(s) for easy and regular access to climate information, forecasts, services and warnings developed and operational.
 - KPI-CS16: Early warning system for ENSO developed, established, implemented and maintained/sustained.

- KPI-CS17: Traditional information/indicators collected and integrated with modern climate sciences, forecasts, information, services and warnings.
 - KPI-CS18: Validation on monthly to seasonal climate prediction for all weather and climate observation stations conducted.
- KO 5. Drought information, forecasts, services and warnings are developed and routinely improved.
 - SO 5.1 Information and communications products and services from the Climate Division are routinely produced according to VMGD policy guidelines and quality management standards.
 - KPI-CS19: Climate summary for Vanuatu produced each year.
 - KPI-CS21: Early warning system for droughts developed, implemented and maintained/sustained.

Of particular interest to the agriculture and livestock sector:

- KO 6. Agrometeorology services are established and routinely improved.
 - SO 6.1 Climate Division in partnership with national agencies, regional and international partners has a strategic development plan for the development of agrometeorology together with the DARD with a view to producing quality agrometeorological products and services to the agriculture sectors including farmers.
 - KPI-CS23: Agriculture Department working together with VMGD to develop a national agrometeorology program; and assisting agriculture sectors and farmers to integrate and use climate information, forecasts, services and warnings in their operations.

Vanuatu Framework for Climate Services (VFCS)

Recommendations⁴⁹

- More monitoring of climate-related impacts on agricultural and livestock productivity is required, and an impacts database needs to be established.
- More research (working with the nurseries) into relationships between climate (particularly thresholds) and crop responses, and new research into climate and animal/crop diseases, pests and invasive species.
- Measurement of additional climate variables (e.g. soil temperatures) would be useful, as would the mapping of agroclimatic high risk “hot spots”.
- There is also a specific need for the Agriculture and Livestock Department to work together with VMGD on creating a National Drought Policy including thresholds for activities, actions.

⁴⁹ SPREP, Vanuatu Framework for Climate Services, 2016.

Climate Change and Agriculture in Vanuatu: A study of Crops and Farming Systems

General Recommendations:

Strategies recommended must be sustainable and resilient to climate change. Many small island states have looked to traditional knowledge as a way forward and combining traditional knowledge with science is another option. However, we must not become too romantic about traditional knowledge. We must make calculated decisions when implementing traditional knowledge and be mindful of where and when to use it. We must also be mindful of when, where and how to combine it with science.

- The Department of Agriculture and Rural Development and other line agencies representing the Government in collaboration with non-government organizations must provide awareness on climate change and its impacts in Vanuatu across the full range of stakeholders. Climate change–agriculture interactions must be included in planning and on-going agricultural development programs.⁵⁰
- The Government through relevant agencies must collect valid and comprehensive agricultural data at appropriate local and national scales. These data must allow national, regional and international institutions to engage in analysis and make projections, development, improvement and implementation of climate-smart strategies and policies.
- The Government through the Vanuatu Agricultural Research and Training Center (VARTC) must include climate change as a high priority research question. It must expand its knowledge on climate smart farming systems and climatic tolerance/sensitive crops of importance to Vanuatu and its islands through national researches. It must conduct basic husbandry and production researches, improve understanding of the complex relationships between climate change and agriculture and understand how these links can impact on food production and security.
- The Government must increase its capacity and capacity building by developing institutional arrangements for knowledge sharing at national, regional and international levels; improve education and training; encourage programs of action and government/private sector partnerships; and transfer knowledge of adaptation options on climate change and agriculture issues and concerns.

The Government through the Vanuatu Meteorology and Geo-Hazards Department must improve and strengthen national climate forecasts. In addition, it must strengthen the partnership between meteorology and agriculture to improve and strengthen awareness of the use and uses of climate forecast information.

⁵⁰ FAO, Climate Change and Agriculture in Vanuatu: A study of crops and farming system, 2013

National Climate Change Adaptation Strategy (NCCAS)⁵¹

The NCCAS notes that Vanuatu acknowledges the Intergovernmental Panel on Climate Change (IPCC) predictions and its possible impacts on agriculture in Vanuatu:

- “Variable rainfall will cause soil degradation and loss of soil fertility which will negatively impact on agriculture and food security;
- If the intensity of tropical cyclones increases, a concomitant rise in significant damage to food crops;
- rural and inland settlements and communities are more likely to be adversely affected by negative impacts on agriculture, given that they are often dependent upon crop production for many of their nutritional requirements.”

The NCCAS also provides in Appendix 1 an SPC-GIZ Coping with Climate Change table. This table thoroughly outlines the impact on sectors and specific adaptation strategies against droughts, cyclones, fire flooding, heat stress and sea level rise.

National Sustainable Development Plan 2016-2030

The NSDP articulates the country’s main development priorities for the next 30 years. Of particular importance under the environmental goals and policy objectives are:

- ENV 1 – Food and Nutrition Security⁵²
 - ENV 1.1 – Increase agricultural and fisheries food production using sustainable practices to ensure sufficient access to affordable and nutritious food.
 - ENV 1.4 – Improve access to appropriate technology, knowledge and skills in food production, preservation and storage.
 - ENV 1.1 – Enhance traditional agricultural practices, focusing on disaster risk reduction and climate change adaptation.
- ENV 3 – Climate and Disaster Resilience⁵³
 - ENV 3.2 – Improve monitoring and early warning systems.
 - ENV 3.4 – Promote and ensure strengthened resilience and adaptive capacity to climate related, natural and man-made hazards.
- ENV 5 – Ecosystems and Biodiversity⁵⁴
 - ENV 5.6 – Enhance environmental monitoring, evaluation and research with relevant, open and transparent data sharing among relevant agencies

51 National Climate Change Adaptation Strategy for Land-Based Resources, (2012 – 2022), Second Draft, July 2011

52 Government of the Republic of Vanuatu, Vanuatu 2030 The people’s plan: National Sustainable Development Plan 2016 - 2030, 2015

53 Government of the Republic of Vanuatu, Vanuatu 2030 The people’s plan: National Sustainable Development Plan 2016 - 2030, 2015

54 Government of the Republic of Vanuatu, Vanuatu 2030 The people’s plan: National Sustainable Development Plan 2016 - 2030, 2015

Republic of Vanuatu National Climate Change and DRR Policy 2016-2030

The document notes that potential impacts of climate change on Vanuatu's agriculture, fisheries, forestry, tourism, health, transport and infrastructure sectors were considered. Projected consequences of climate change include:

- reduced availability of fresh water;
- shifts in crop seasonality of harvest, planting and fruiting;
- more pests and diseases of animals, crops and trees;
- compromised food security⁵⁵

Vanuatu National Adaptation Programme of Action

It notes that that the main climate issues and possible adaptation options in each province are⁵⁶:

Climate Issue and Vulnerabilities	Adaptation Options
TORBA Province	
Conflict with traditional calendars and natural indicators	<ul style="list-style-type: none"> • Improve climate change understanding at provincial and community levels
SANMA Province	
Water scarce areas vulnerable to droughts	<ul style="list-style-type: none"> • Increase rainwater catchment and storage capacity • Establish water distribution facilities
Agricultural crops affected by increased temperatures, cyclones and prolonged/intense rainfall	<ul style="list-style-type: none"> • Diversification of crops and improve crop varieties. • Carry out study on farm irrigation
PENAMA Province	
Agricultural crops affected by increased temperatures, cyclones and prolonged/intense rainfall	<ul style="list-style-type: none"> • Diversification of crops and improve crop varieties and implement agricultural best practices • Revival of traditional food preservation techniques
MALAMPA Province	
El Niño events result in drought	<ul style="list-style-type: none"> • Increase rainwater catchment and storage capacity • Establish water distribution facilities • Enact bylaws to protect and manage watershed areas
Farming and logging in water catchment areas	<ul style="list-style-type: none"> • Control of the issuance of logging licenses and closely monitor logging and farming activities • Enact bylaws to protect and manage watershed areas
SHEFA Province	
Declining crop production	<ul style="list-style-type: none"> • Develop improved crop varieties and implement best agricultural practices and diversification of crops

55 Government of the Republic of Vanuatu, Vanuatu Climate Change and Disaster Risk Reduction Policy 2016 - 2030, 2015

56 Government of the Republic of Vanuatu, National Adaptation Programme for Action (NAPA), 2007

Significant vulnerability to droughts especially on smaller islands due to lacking/limited underground water and limited capacity to capture and store rainwater	<ul style="list-style-type: none"> • Increase rainwater catchment and storage capacity
Farming and logging in water catchment areas	<ul style="list-style-type: none"> • Ban/Control sand mining • Develop ICZM plan • Establish reserve in central Efate
TAFEA Province	
Agricultural sector, especially crop planting and harvesting are strictly governed by customary tradition. Though shifts in climate patterns are being observed people are reluctant to change agricultural practices accordingly because of strict customary practices	<ul style="list-style-type: none"> • More awareness needed to improve the understanding of communities on climate
West part of Tanna experiencing prolonged droughts that are affecting agriculture and tourism sectors	<ul style="list-style-type: none"> • Development of improved crop varieties, best agricultural practices and diversification of crops
Farming, logging and settlements around water catchment areas	<ul style="list-style-type: none"> • Increase rainwater catchment and storage capacity • Establish water distribution facilities • Enact bylaws to protect and manage watershed areas

The NAPA also noted the following adaptation strategies.⁵⁷

- Rainwater harvesting
- Desalination and other alternative water sources
- Water management policies/programmes
- More resilient crop species including traditional varieties
- Agriculture and food security (preservation/processing/marketing, modern and traditional practices including bartering)
- Agricultural land use planning and management (modern and traditional practices, early warning including traditional systems)
- Sustainable land use management and planning
- Enhance meteorological observations network nationwide (terrestrial and ocean) and develop early warning systems using contemporary and traditional techniques
- Sustainable Livestock farming and management

⁵⁷ Government of the Republic of Vanuatu, National Adaptation Programme for Action (NAPA), 2007

The final list of adaptation strategies was ranked as follows:⁵⁸

1. Agriculture and food security (preservation/processing/marketing, modern and traditional practices, bartering).
2. More resilient crop species including traditional varieties.
3. Land use planning and management (modern & traditional agricultural practices, early warning including traditional systems).

Sustainable livestock farming and management:

It was noted that the top 3 ranked projects were from the agriculture sector. This was hardly surprising given the importance of this sector to the largely rural population of Vanuatu, and its vulnerability to climate change and climate variability.⁵⁹

Part II of the NAPA outlines project concepts of which Agriculture and Food Security is number one. It notes the following as regards climate and agriculture:

Low productivity and small holdings are the key constraints towards expansion and commercialization of agriculture in Vanuatu. There is little incentive to enhance productivity through use of modern methods and technology. The sector is also vulnerable to change in world prices. Copra and cocoa are the main commodities that have been affected by this to a large degree. Soil degradation is also affecting production. The traditional method of shifting cultivation is no longer practical given the increased demand for land from the rising population. Agro-forestry is being promoted, with the use of intercropping to reduce soil degradation, but its impact has been limited.

The increasing incidence of extreme events and climate change is adding to the stress on this sector. There is little additional information on the effect these changes will have on the other cash crops such as yams, taro and sweet potatoes that are important for the sustenance of the ni-Vanuatu people. The issue is further complicated by the lack of mechanisms to enhance storage to meet shortfalls during times of disasters. Climate related disasters are already impacting production through salt water intrusion, droughts, soil erosion and cyclones. The projected increase in cyclone frequency and intensity further heightens the vulnerability of the agriculture sector. Destructive winds and heavy rainfall associated with cyclone events may result in widespread crop damage.

Crop production has decreased significantly as a result of increased temperatures, more frequent and prolonged dry conditions and increased variability of rainfall. Pest activities have also increased with yams being the crop most affected by a tuber-eating beetle that induces rotting. Cyclone incidences however remain the major threat to the sector, often severely damaging subsistence crops.

Annual average temperatures are projected to increase to 28.8 °C and 29.7 °C by 2050 and 2080 respectively under the selected climate change scenarios. With these projected elevations in temperatures, heat tolerance thresholds of crops are likely to be reached and most likely induce heat stress, wilting and crop failure. Subsistence crop production may fall as a result and in turn threaten food security. Impacts may be aggravated in the event of El Niño episodes, which are expected to

⁵⁸ Government of the Republic of Vanuatu, National Adaptation Programme for Action (NAPA), 2007

⁵⁹ Government of the Republic of Vanuatu, National Adaptation Programme for Action (NAPA), 2007

cause extreme dry spells in future. Furthermore, in a warmer environment, people will be forced to reduce working hours to the early hours of the morning and the cooler hours of the afternoon and early evenings, hence reducing productivity.

Increased precipitation scenarios may increase annual averages by 200 mm by the 2050s and 280 mm by the 2080s. Prolonged wet conditions and warmer temperatures may create conditions favourable for pests and diseases, which may flourish and affect production and food security significantly.

Traditionally through a system of bartering and shifting agriculture the people have managed to deal with these events. However, given the shortage of land and the increased incidence of these events, these mechanisms are no longer adequate.⁶⁰

Republic of Vanuatu Second National Communication to the UNFCC

The sectors considered in this assessment to be most vulnerable for climate change are: Agriculture (crops, cattle and sustenance), Fisheries (freshwater, coastal, deep sea, aquaculture), Forestry (including mangroves and production forest), Tourism (cruise-ships, hotels), Transport (road, ferries, and air), Infrastructure (utilities [energy, water, and sanitation], houses, offices, and industry) and Health.

Vanuatu has an agriculture-based economy with at least 80% of the population residing in the rural areas and depending on subsistence agriculture for their livelihood. Any changes in rainfall distribution, both in terms of the amounts of rain and its spatial as well as temporal distribution could have severe impacts on agricultural production. Drought combined with higher temperatures would lead to greater evaporation, reduced availability of water for agriculture and added thermal stress on plants.⁶¹

Soil degradation is an important issue affecting agriculture. The traditional practice of shifting cultivation that allowed the soil to go through a process of regeneration by being left idle for extended periods ranging from 5-10 years is no longer possible. The numerous effects of climate change and variability: cyclones, flash floods, high rainfall, high temperature and long dry periods will make agricultural production very challenging in Vanuatu.

The production of beef, pork, poultry, sheep and goat for local consumption forms an essential part of the rural economy. Climate change is likely to have a far greater effect on the small farmers compared to the larger commercial operations.⁶²

The primary priority for the Government is to create an environment for private sector led economic growth, including activities in the primary sectors of agriculture, forestry and fisheries, as well as in tourism. This includes public sector reform and good governance, improving the investment,

60 Government of the Republic of Vanuatu, National Adaptation Programme for Action (NAPA), 2007

61 Government of the Republic of Vanuatu, Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2014

62 Government of the Republic of Vanuatu, Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2014

operating and regulatory environment for the private sector, and providing the necessary infrastructure and support services, particularly in rural areas, for the primary sectors and tourism as well as in the urban centres. At the next level of priority is human resource development. As the economy begins to grow, an increasing number of economic and employment opportunities will be created for both men and women. This will require a skilled, educated and motivated gender-balanced labour force. Adequate resources need to be provided to ensure that education and training is provided for all people across all levels of ability to enable everyone to achieve their own highest levels of potential.⁶³

In the year 2000, the Agriculture sector was the biggest source of GHG emissions in Vanuatu. It was responsible for 85.8% (502.83Gc CO₂ e.) of emissions where Methane was the main GHG emitted as a result of extensive agricultural activities in Vanuatu. Methane is considered a strong GHG with global warning potential 21 times that of CO₂.⁶⁴

It is observed that nearly 99% of GHG emissions in Vanuatu come from five activities: energy, transport, livestock, N₂O from agriculture soils and waste. The biggest contributors are livestock and N₂O emissions from agriculture soils. Vanuatu has a limited industrial sector and relatively poor energy infrastructure; which results in a high share of GHG emissions from agriculture sector. Department of Agriculture in Vanuatu needs both technical and financial support to come up with mitigation plans to reduce GHG emissions from the agriculture sector.⁶⁵

The GHG emissions trend for Vanuatu for 2000-2010 show that the agricultural sector is still the highest emitter of GHG during this period, where the emissions increased by 17% primarily due to increased livestock during the period. There are two sources of GHG emissions from livestock farming; Enteric fermentation and manure management.

Agriculture and Climate Change

The prevalence of wetter conditions in the future would benefit water-sensitive crops such as coconut, breadfruit, and cassava.

Vanuatu's future climate scenario projections as per the above section for the 21st century shows that, the average minimum, mean and maximum daily temperatures will increase and potential direct impact on agriculture sector includes the shifts in crop-seasons (all phases will happen earlier and faster). This will have a direct impact on the economy and livelihood.

Considering the uncertainty of future climates, assessments of climate change on Vanuatu's agriculture can only be broad. Variability of rainfall will increase the demand for drought-resistant crops in drier areas and for water tolerant crops in wetter areas. Farmers may modify their crop calendars, shift their cropping patterns, diversify the crops grown, or completely shift out of crop

63 Government of the Republic of Vanuatu, Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2014

64 Government of the Republic of Vanuatu, Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2014

65 Government of the Republic of Vanuatu, Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2014

agriculture. Overall, it is expected that agriculture loss in Vanuatu from climate change outweigh any projected benefits. The risks include crop losses from excess heat and drought on the one hand, and oversaturation of soil and physical damage from increased rainfall on the other.

Vanuatu has one of the most conducive environments for raising livestock. The production of beef, pork, poultry and sheep and goat for local consumption forms an essential part of the rural economy. Climate change is likely to have a far greater effect on the small farmers compared to the larger commercial operations. Small and subsistence farms often rely on streams for their water supply and do not have the means to set up adequate water storage facilities. As the streams dry up the farmers find it hard to cope. Further, there has been increased incidence of intestinal problems in cattle often associated with pasture. Similar problems (worm and infections) have been encountered by the piggery farmers. The increased demand for land and its enhanced degradation due to climate extremes and other hazards have added to the challenges of this sector.⁶⁶

The Department of Agriculture and Rural Development has taken the lead in coordinating the agricultural sector in regard to climate change and disaster risk reduction. In 2013, the department released a National Agriculture Position on Climate Change & Disaster Risk Reduction which outlined the key adaptation priorities for the country, and sets out a clear policy directive, to coordinate and guide all actors, regarding climate change and the development of its agriculture sector. The 2013 Position statement indicates that the adaptation priorities for new programs and projects on agriculture, climate change and disaster risk reduction should highlight and take into consideration the following priority solutions:

- introduction and improvement of climate resilient crops for cultivations by local farmers,
- preservation and improvement of local and endemic crops that hold climate resilience and environmental suitability,
- introduction and improvement of farming systems that enable adaptation or climate resilience,
- uptake, up scaling and dissemination of climate resilient crops and technologies,
- overcoming barriers to increased production and food security, and
- economic analysis and cost benefits of climate resilient agriculture.⁶⁷

Pacific Roadmap for Strengthened Climate Services (PRSCS)

As regards Agriculture and Food Security, the PRSCS noted the following: “There are several ongoing programs and projects underway within the Global Framework for Climate Services (GFCS) from local to global scales for improving the management of climatic risks in agriculture, such as early warning systems and agricultural advisories for farmers, policy planners, industry and other stakeholders. Good quality and reliable weather and climate data are essential for climate risk assessment, and

⁶⁶ Government of the Republic of Vanuatu, Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2014

⁶⁷ Government of the Republic of Vanuatu, Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), 2014

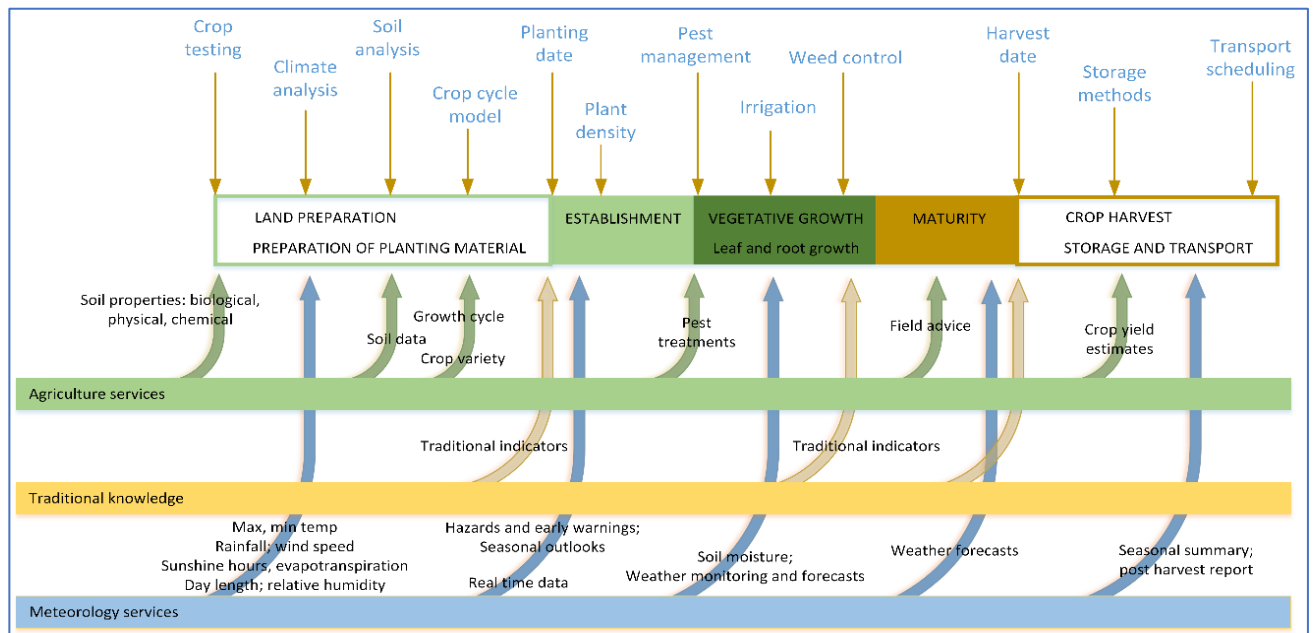
mapping of crop distribution, phenology, yield potential and vulnerability indicators including adaptation capacity, land suitability and surface and groundwater availability. Fortunately, advanced tools such as automatic weather stations, global circulation models, regional climate models, numerical weather prediction models, and downscaling techniques are more widely available to address stakeholder needs for value-added information.”⁶⁸

Year-to-year climate variability has a large influence on agricultural production. Longer-term systematic changes in climate, which are modifying historical measures of climate variability, have introduced a new complicating factor. Any increase in the frequency and intensity of extreme events such as floods and droughts will affect grain, horticultural, forestry and livestock production. Typical agricultural studies and activities in Pacific Island countries that climate services can support include:

- The responses of traditional crops, e.g. sweet potato, cassava, taro, banana, breadfruit and yam to existing environmental drivers (e.g. climate variability and extremes, soil and nutrient interactions)⁶⁹.
- Understanding the responses of island crops to enhanced CO₂.
- Developing and enhancing the capacity to model crop and cropping systems.
- Estimating appropriate stocking rates for those areas involved in commercial animal husbandry.
- Identifying farming system adaptation strategies given the risk profiles associated with both climate variability and change.
- Examining the economic value of specific operational seasonal climate forecasts in supporting agronomic management decisions for the production of Pacific staple food crops, e.g. assessing the risk of shortages in specific food crops.
- Development of a Communication, Partnership and Engagement Strategy.

68 Managing Climatic Risks to Combat Land Degradation and Enhance Food security: Key Information Needs: P.K. Aggarwal, W.E. Baethegan, P. Cooper, R. Gommers, B. Lee, H. Meinke, L.S. Rathore and M.V.K. Sivakumar. World Climate Conference 3, Procedia Environmental Sciences

69 Pacific Root Crops: <http://www.fao.org/docrep/013/am014e/am014e04.pdf>



Crop management decision time-line: a workflow model

Climatological Data for Agriculture

Clearly rainfall and more specifically deficiencies in expected rainfall totals during a crop's growing season are a critical factor in determining productivity. Hence the detection of incipient drought and its onset, the monitoring of its duration and severity are primary climate services for agriculture. Assessing the risk of future drought on seasonal time-scales using predictive tools is also a crucial climate service.

The WMO OSCAR⁷⁰ project provides a comprehensive description of meteorological data needs for agriculture.

<http://www.wmo-sat.info/oscar/applicationareas/view/7>

Agricultural Data

Considerable effort continues on digitising weather and climate records across the Pacific. Unfortunately, the availability of historical crop production data in digitised forms is considerably more fragmented. Ideally, a complementary effort is needed to digitise historical data on crop production and other relevant agricultural parameters by region/island wherever the data are available. Further, systematic recording and archiving of future data on agricultural characteristics, e.g. soil types, and production should be introduced where such activities do not already exist.

OSCAR (Observing Systems Capability Analysis and Review) is a resource tool developed by WMO in support of earth observation applications, studies and global coordination. The following table shows

the environmental variables recommended by OSCAR for measurement to serve the needs of Agriculture. It will be important for this table to be reviewed and refined to meet the needs of the Pacific region.

Subdomain	Variables		
Basic atmospheric	Air specific humidity (at surface) Wind speed over the surface (horizontal)	Air temperature (at surface) Wind vector over the surface (horizontal)	Atmospheric temperature
Clouds and precipitations	Accumulated precipitation (over 24 h)	Precipitation intensity at surface (liquid or solid)	Precipitation intensity at surface (solid)
Aerosols and radiation	Downward short-wave irradiance at Earth surface	Fraction of Absorbed PAR (FAPAR)	
Ocean	pCO2		
Land surface	Fire fractional cover Land surface temperature Snow cover Soil type Soil temperature	Fire temperature Leaf Area Index (LAI) Snow water equivalent Vegetation type Wind gust	Land cover Normalised Difference Vegetation Index (NDVI) Soil moisture at surface Evapotranspiration
Atmospheric chemistry	O3		

Recommended environmental variables for Agricultural sourced from WMO Oscar

Development of crop calendars should also be encouraged, for example along the lines of that prepared for the Vanuatu Ministry of Agriculture with support from the SPC/GIZ⁷¹ project *Coping with Climate Change in the Pacific Island Region* (see Figure 6).

Crop Calendar

Crop type	Harvesting season	Spacing	Planting season
Oi Krop we yu save harvestem afta lo 1 manis kasem 3 manis			
Radish	1 - 1.5 months AP	0.25m X 0.25m	Year round
Island cabbage	1 - 1.5 months AP	0.5m X 0.5m	Year round
Chinese cabbage	2 months AP	0.4m X 0.3m	March - September
Bean	2 months AP	0.7m X 0.5m	March - August
Lettuce	2 - 3 months AP	0.4m X 0.3m	March - September
Parsley	2 - 3 months AP	0.4m X 0.2m	March - October
Tomato	2 - 3 months AP	0.7m X 0.6m	February - September
Water melon	2 - 3 months AP	2m X 1.5m	Year round
Oi Krop we yu save harvestem lo 3 manis kasem 6 manis			
Beetroot	3 months AP	0.4m X 0.2m	March - August
Irish potato	3 - 4 months AP	0.8m X 0.4m	April - September
Kumala	3-5 months AP	1m X 0.5m	April - September
Eggplant	4 - 5 months AP	0.7m X 0.6m	Year round
Spring onion	4 - 6 months AP	0.4m X 0.2m	March - July
Oi Krop we yu save harvestem lo 6 manis igo antap			
Onion	6 - 7 months AP	0.4m X 0.2m	April
Cassava (Manioc)	6 to 9 months AP	1m X 1m	Year round
Oi Krop oli gat ol spesifik manis blo harvestem			
Yam	April to June	1m X 1m	August - September
Pineapple	November to January	1.5m X 0.4m	January - June
Oi Krop we yu save harvestem thru aot lo yia			
Island taro	Year round	1m X 1m	Year round
Taro Fiji	Year round	1.5m X 1m	Year round

Figure 6: Example Crop Calendar for Vanuatu

Figure 6 shows a crop calendar for the major crops in Vanuatu with information arranged by harvest season (shortest to longest), planting, growth and harvesting timings and periods for different crops. The calendar suggests benefits to be gained in attuning climate services to the needs of specific crops. As also can be seen from this table, there is now considerable diversification in agriculture in some Pacific Island countries beyond the traditional subsistence crops such as cassava, taro and yam.⁷²

Regional and National Actions for Agriculture

Table 8 lists recommended actions that can be undertaken under GFCS Pillars to enhance CIS for agrometeorology.

Table 8: Agriculture National and Regional Actions

NUMBER	LEAD GFCS PILLAR	ACTION	NATIONAL ACTIVITY / REGIONAL ACTIVITY
1	User Interface	With agriculture advisers/extension officers, develop drought management plans for different subsistence and cash crops	National
2	Climate Services Information System	Map Normalised Differential Vegetation Index (NDVI) estimates from satellites	Regional
3	Climate Services Information System	Prepare agrometeorological advisories, crop calendars, crop models, seasonal outlooks for crop yield forecasts	Regional and National
4	Climate Services Information System	Provide drought, irrigation and seasonal climate advisories to assist farmers	National
5	Observations and Monitoring	Explore the use of agricultural extension officers as a resource for collecting routine meteorological and other agricultural data.	National
6	Research, Modeling and Prediction	Source estimations of (potential) evapotranspiration from climate models	Regional and National
7	Research, Modeling and Prediction	Explore the impacts of climate change and changing seasonality on agriculture (e.g. salt-water intrusion etc)	Regional and National
8	Capacity Building	Increase the capacity of agrometeorology personnel	Regional and National

72 SPREP, Pacific Roadmap for Strengthened Climate Services, 2017

Vanuatu Coastal Adaptation Project (VCAP)

One of the outcomes of VCAP stakeholder engagement was the following information:

Climatic impacts on agriculture can lead to disease outbreaks and crop failure. Early knowledge of the onset of climatic conditions that trigger heavy rainfall or drought could greatly assist in prevention, planning, and early action.

The tables starting on the next page describe the weather and climate information that could help manage climatic impacts on agricultural production and food security, as discussed in the workshop.

After a follow-up meeting with sector representatives, the following were prioritized as the initial needs for climate information:

1. Daily climate data for DSSAT models as .csv file (agriculture to advise details of what is required)
2. Monthly bulletin as a .pdf file including:

Cumulative rainfall, Soil Moisture, Temperature to date, Rainfall deficit monitor, Rainfall/Drought forecast, Temperature forecasts, Agro-met bulletin, ENSO outlook, Actions/recommendations based on forecasts.⁷³

Risk or concern	Climate and weather triggers	Whom does it affect? (i.e. government, private sector, and communities)	Why is it a problem? What is the impact (socially, economically and culturally)?	Would early warnings of the climate triggers be helpful?
Soil erosion and structure breakdown	Heavy rainfall and prolonged wet periods	Communities and farmers; Transportation of produce	Soil loss of agricultural land, leaching; damage to roads and bridges, other infrastructure	Early warning of heavy rainfall; seasonal climate; adaptive measures
Pest and disease outbreaks (e.g. Anthracnose in yams)	Frequent rainfall; high humidity; temperature within infection range (24-29.5°C)	Farmers	Loss of crops and yield; unmarketable produce; loss of income and food security.	Repellent plants (herbs); seasonal rainfall – dry season
Fungal diseases	Prolonged period of rainfall; high humidity	Crop losses	Reduce crop yield; loss of income and food security	Early warnings of heavy rainfall; seasonal rainfall
Crop production slumps	Prolonged wet or dry periods	Crop losses, farmers and livestock e.g. sweet potato, dryland taro	Loss of income/ food security	Seasonal forecast of rainfall and dry periods; time series data
Extreme weather and agricultural impacts	Tracking climate and unusual weather anomalies	Crops; livestock and transport.	Economic and cultural losses	Seasonal forecasts; time series data.
Drought; dry conditions; crop withering	Low rainfall for 15 days or more	Crops and livestock	Affects crop yield; reduced production; loss of income	Early warning of dry periods and drought; seasonal forecasts; time series data.

Risk or concern (copy from above if early warning would be helpful)	What actions could be taken with early warnings?	What data/ information is needed for the action?	How (i.e. email, text, radio) should the early warnings be communicated and how often?	Who will communicate the warnings and to whom?
Soil erosion and structure breakdown	Warn farmers to plan ahead; Up to date rainfall	Daily and monthly rainfall data; Weekly reports	Daily email, text, radio bulletins Daily and weekly forecasts and observations (Map, raw data, time series).	DARD E.O → farmers (Department of Agriculture and Rural Development)
Pest and disease outbreaks	Need disease outbreaks based on weather forecasts.	Identify isolated infection zones.		DARD E.O → farmers
Fungal diseases	Literature search on infection periods	Daily/weekly/monthly reports.	Email. Radio. Quarterly newsletter; text.	
Crop production slumps	Need weather forecasts.	Daily data feed for model runs (e.g. DSSAT)	DSSAT models	Direct file transfer- ftp Analyse → DARD E.O → farmers
Extreme weather and agricultural impacts	Warn farmers to plan ahead for adverse conditions. Time series data and graphs.	Agriculture bulletins/advisories; monthly data and maps Precipitation index (SPI)	Monthly Climate Update Quarterly Agriculture News Bulletin	Email DARD E.O → farmers climate Briefings
Drought; dry conditions; crop withering	Warn farmers to plan ahead. Use mulching to conserve water.	Daily tracking of dry periods Soil water content reports	Daily	DARD E.O → farmers

Sector	What climate data/ information is the priority for early warnings?	In what format (i.e. email, text, radio) should the early warnings be communicated?	How often?	Who will communicate the warnings?	To whom?
Agriculture and livestock	1. Daily climate information for DSSAT models as .csv file (agriculture to advise details of what is required)	E-mail .csv file	Daily	VMGD to key Agriculture rep	Agriculture to enter into DSSAT model
	2. Bulletin including: A. Cumulative rainfall B. Soil moisture C. Temperature to date D. Rainfall deficit monitor E. Rainfall/ drought forecast F. Temperature forecasts G. Agro-met bulletin H. ENSO outlook I. Actions/ recommendations based on the forecasts	E-mail .pdf file	Monthly	VMGD to key Agriculture rep	Agriculture to disseminate to the public as required