KLAEMET SAVE
REDI · ADAPT · PROTEKT

VANUATU TRADITIONAL KNOWLEDGE
NATIONAL INDICATOR BOOKLET

GREEN CLIMATE FUND

Australian Government
Bureau of Meteorology

SPREP PROE

Booklet produced on behalf of VMGD by the Vanuatu Klaemet Infomesen blong Redi, Adapt mo Protekt (VanKIRAP) Project, with support from the Australian Government Bureau of Meteorology and the Vanuatu Cultural Centre (VKS).

The VanKIRAP Project is implemented by the Secretariat of the Pacific Regional Environment Programme (SPREP) in partnership with the Vanuatu Meteorology and Geo-hazards Department (VMGD), and is funded by the Green Climate Fund.

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Director's Statement

It gives me great pleasure to formally launch the Traditional Knowledge Climate and Weather Indicator Booklet that has been successfully compiled by VanKIRAP project for the Department of Meteorology and Geo-Hazards Department (VMGD) under the Ministry of Climate Change (MOCC) in 2023.

The booklet is a finished product under the Traditional Knowledge component of the VanKIRAP Project which compiles all the traditional knowledge indicators of weather and climate in Vanuatu purposely to educate the people of Vanuatu on the importance of using our own traditional knowledge and skills as tools to help us, as part of our early warning actions during disasters events.

This booklet is also a step forward of achieving the national governments NSPD People's Plan, targeting two pillars— the Society Pillars 1 and Environmental Pillar 3.

I wish to express my sincere thanks to all the stakeholders and government departments' supports as well as support from our regional partners the Secretariat of the Regional Environment Programme (SPREP) and Australia's Bureau of Meteorology (BOM) for the great support given for the completion of this work.

I also would like to thank all the Traditional Knowledge holders around Vanuatu for allowing their stories to be publish in this booklet, and to acknowledge the support this booklet has received from the Vanuatu Kaljarol Senta.

Lastly, thanks to the VanKIRAP Project staff and the Green Climate Fund for the continuous financial support for the completion of this booklet.

Montine Romone
Director, Vanuatu Meteorology and Geo-hazards Department

Executive Summary/Foreword

Traditional Knowledge is now becoming a newly recognized practice in sustainability of the environment and climate in the world of global warming. Before western civilization, Vanuatu survived through the ages with its practiced customs, traditional practices and being able to predict seasonal futures and extreme weather events through the behavior of plants, animals, and meteorological and astronomical signs.

Vanuatu Traditional Knowledge (Indigenous Knowledge) in predicting the weather, seasons and extreme events has been practiced and passed on from generation to generation. Vanuatu Meteorology & Geo-Hazards Department (VMGD) has recognized traditional knowledge is a more sustainable way and a more accessible method of understanding and predicting the weather and climate for many community members. The VMGD has taken a step back, back to its roots, to collect Traditional Knowledge relevant to all communities and has re-tailored this information and returned it back to the community to use.

Through the support and initial works by the COSPAC project, Van-KIRAP project has taken on the vision to reach the last mile, leaving no one behind when it comes to communicating forecasts and warnings. As part of this process VMGD, through Van-KIRAP project, has developed this Vanuatu National Traditional Knowledge Indicators Booklet. The booklet contains a record of all common weather and climate traditional knowledge indicators of animals, plants, and astronomical phenomena from around Vanuatu.

The Vanuatu National Traditional Knowledge Booklet will be a platform, amongst other tools, providing accessibility around Vanuatu for local indigenous community. This booklet is an educational resource for all communities to return to their cultural roots and to continue practicing a more sustainable and easily interpreted material that will help them with simple but resilient decisions to safeguard them during any forecasted weather and/or climate event.

Acknowledgement of TK holders
We would like to acknowledge all the TK holders from Torba, Sanma, Malampa, Shefa, and Tafea province for their hard work and support towards the work of Traditional knowledge to collect stories and indicators that could help understand Vanuatu local ways of predicting different season of weather. This booklet cannot be complete without your help and support, and for that would also like to express our gratitude to those who shared their traditional knowledge using the different indicators discussed in this booklet. Finally, we would like to extend this thanks to others who have gratefully participate in any way to carry out the work of Traditional knowledge that helps achieve the goal of TK.

Introduction

This book highlights indigenous weather and climate forecasting knowledge of the ni-Vanuatu. This knowledge is documented and shared so that it can be used effectively in disaster risk reduction, particularly in remote and less accessible regions of Vanuatu as well as providing a national cultural resource.

Ni-Vanuatu have a rich cultural tradition that includes the close observation of nature. The ability to note significant changes in the natural environment has allowed generations of people living off the land to forecast and prepare for climate and weather events, such as cyclones and seasonal changes to and from the wet and dry seasons.

The knowledge depicted in this book is divided into three main sections, predictions related to the cyclone season, the wet season, and the dry season. Although the cyclone season and the wet season have significant overlap, we have separated knowledge directly related to cyclones from more general knowledge related to wet conditions/seasons.

What is TK?
Traditional Knowledge, also known as traditional ecological knowledge or indigenous knowledge, is knowledge that is based on repeated observations, know-how, skills and practices that are developed, sustained, and passed between generations. It covers both indigenous and non-indigenous peoples and recognises that knowledge can evolve over time. Traditional knowledge, indigenous and local knowledge generally refer to knowledge systems embedded in cultural traditions of regional, indigenous, or local communities.
This book focuses mainly on traditional knowledge related to forecasting climate events, which differ from weather forecasts in the following way. Weather is the state of the atmosphere at a particular place and time and generally refers to short time scales, such as minutes, hours, days or weeks. Climate is the usual conditions of the temperature, humidity, atmospheric pressure, wind, rainfall, etc., over a longer period of time, such as months, seasons, years and decades.

Why is it important?
Local communities in Vanuatu make decisions based on weather and climate forecasts. This includes using traditional forecasting knowledge. Over time this knowledge has been eroded due, in part, to rapid urbanisation and an emphasis on western science. Despite these pressures, traditional knowledge remains highly valuable and relevant, particularly to remote communities where outside communication is hindered and traditional ways remain more relevant.
Many organisations recognise the importance of traditional knowledge, including VMGD, and see the value that this knowledge can add to the delivery and understanding of forecasts and warnings that they issue.

About this Project
This book was developed under the 'Climate Information Services for Resilient Development in Vanuatu' project (Vanuatu Klaemet Infomesen Blong Redy, Adapt Mo Protekt – Van-KIRAP). Its development was coordinated by the Vanuatu Meteorological and Geo-Hazards Department (VMGD), Secretariat for the Pacific Regional Environment Programme (SPREP) and the Australian Bureau of Meteorology (BOM), along with other key partners.

How was the information collected?
A standardised approach to knowledge collection was developed initially under the Climate and Oceans Support Program in the Pacific (COSPPac) and further developed under Van-KIRAP. This approach has protocols and procedures in place that are based upon international best practice and exceed national requirements, such as those listed in the Vanuatu Bill for the Protection of Traditional Knowledge and Expressions of Culture Act No. of 2018. The procedures ensure that the knowledge is collected using Prior Informed Consent, that intellectual property rights are retained, and that any cultural sensitivities associated with the knowledge is acknowledged and respected throughout the entire process – from time of collection to storage of the knowledge, to the development of products.

Members of VMGD, and partner organisations, identified sites within each of Vanuatu's provinces and used these to talk with traditional knowledge practitioners about their traditional weather and climate knowledge using a standardised survey questionnaire as a guide for the conversation. A subset of the information collected, that deemed not to have high cultural sensitivity associated with it, is presented in this book. As such, this document does not cover all traditional knowledge around weather and climate and does not cover all villages in Vanuatu, but we hope that what is presented will start discussions around traditional knowledge and encourage younger generations to reconnect with nature and how it can inform decision making.

For additional information on the traditional knowledge component of the Van-KIRAP project, including how traditional knowledge was collected and stored, see the Further Information page at the end of this document.

List of Species used to forecast future weather and climate

The ni-Vanuatu use observations of plants, animals, astronomy (e.g. the sun and moon), and meteorology (e.g. the direction and strength of winds, cloud patterns) to forecast weather and climate. This book showcases this knowledge. A summary of the animals and plants that have associated climate forecasting knowledge are shown in the table below. The symbol '*' following the Bislama name indicates introduced species. Examples of local names are provided, based on either the interviews in the communities or 'Remarkable Plants of Vanuatu' (Ramon L & C Sam, 2015), noting that the local names provided are likely to be a subset of those used on each island. This list is not exhaustive, and it is hoped that it starts a journey of rediscovery of other narratives around plants and animals used to forecast weather and climate, local names, and customs.

Birds

Bislama Name	English Name(s)	Scientific Name	Local Names
Shot leg	Pacific Emerald Dove	*Chalcophaps longirostris sandwichensis*	Namahie (Santo)
Frigatebird	Lesser Frigatebird or Great Frigatebird	*Fregata ariel* or *F. minor*	Nawuledibobo (Uripiv Vilavi), Nemtane (Diverse Bay)
Faol*	Chicken /Red Jungle Fowl	*Gallus domesticus /Gallus gallus*	Faol
Nasiko	Kingfisher	*Todiramphus sp.*	Napasohi (Santo)
Swallow		Species unknown	Pangamgam (Lehali)

Animals

Bislama	English Name	Scientific Name	Local Names
	Little bent-wing bat	*Miniopterus australis*	
Bullock*	Bullock /Cow	*Bos taurus indicus*	Napulu-ka (Santo)
Dog*	Dog	*Canis lupus familiaris*	
Dolfin	Pacific White-sided Dolphin	*Lagenorhynchus obliquidens*	
Manguru	Runner, Scad	Various species	Manguru
Flaengfis	Flying Fish	*Exicoetidae* (species unknown)	
Flaengfokis	Flying Fox	*Pteropus sp.*	
Frog*	Green and Golden Bell Frog	*Litoria aurea*	
Gren Totel	Green Turtle	*Chelonia mydas*	
Hoksbil totel	Hawksbill Turtle	*Eretmochelys imbricata*	
Honet*	Yellow Oriental Paper Wasp	*Polistes olivaceus*	Hornet
Small bepet	Insects		Small bepet
Leta bak totel	Leatherback Turtle	*Dermochelys coriacea*	Leta bak totel
Palolo worm	Palolo worm	*Palola viridis* or *Palola sicilensis*	
Pig*	Pig	*Sus domesticus*	Napoeh (Santo)

Plants

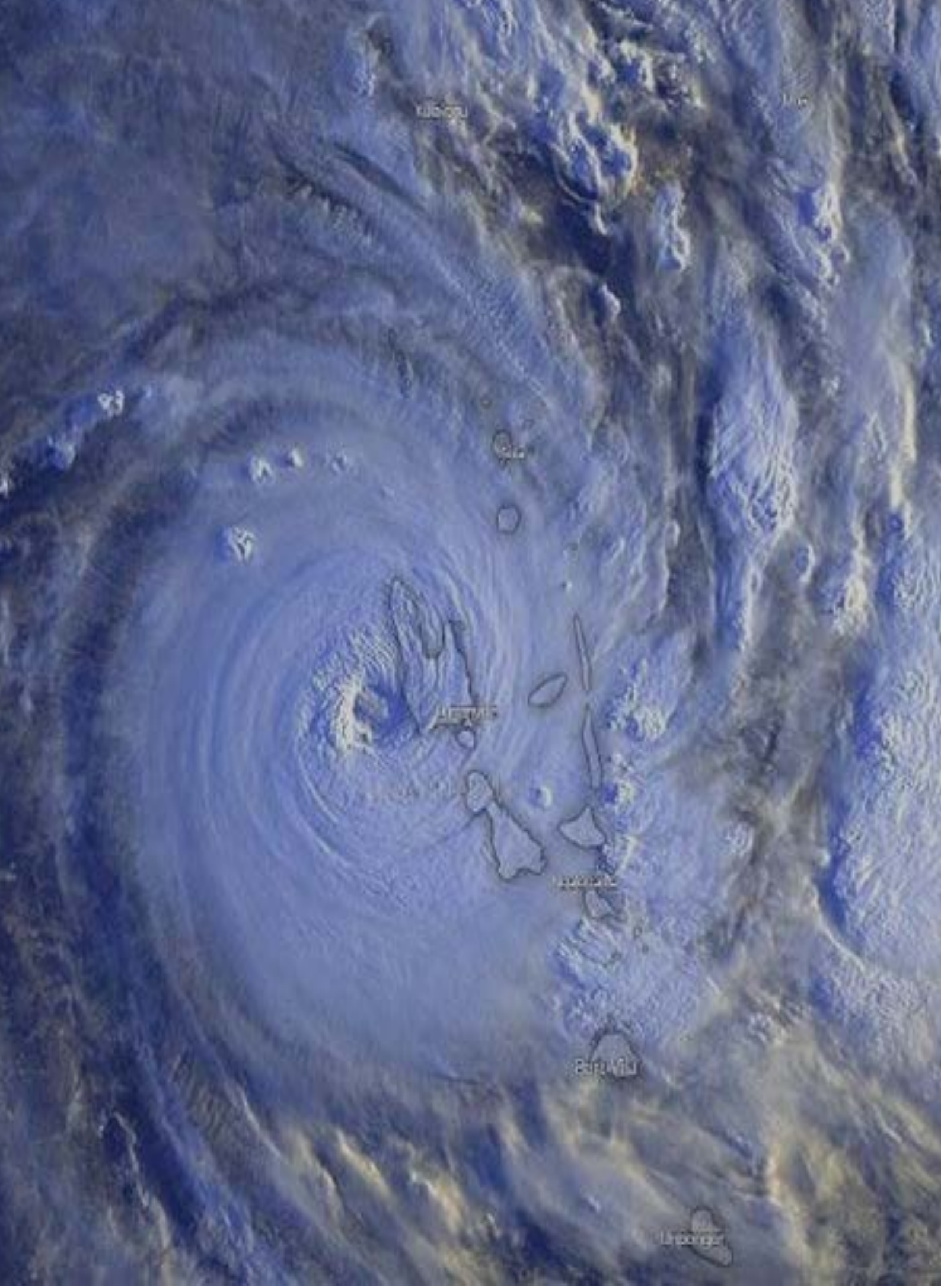
Bislama	English Name	Scientific Name	Local Names
Banana*	Banana Tree	*Musa acuminata*	-
Nabanga tree	Banyan Tree	*Ficus obliqua*	Naowrevi (Aniwa/Futuna), nerere (Aneityum), narawaw (Efate), lalaw (Epi), narivrep (Erromango), bliw and nimbinank (Malekula), rewerep (Pentecost), bol (Santo)
Bluwota	Naranara	*Pterocarpus indicus*	-
Bredfrut*	Breadfruit Tree	*Artocarpus altilis*	Nape-ho (Santo)
Buroa Tree	Beach Hibiscus	*Hibiscus tiliaceus*	Fau (Aniwa/Futuna), inhao (Aneityum), varu/nevei/ver/var (Banks), orenavau (Erromango), taru (Maewo), balgo/na teghvai/nvava (Malekula), voiave ali/voiave ouhaha/voiave tisa (Paama), fae/raava/butsu raava (Pentecost), navai (Santo), nau (Tanna), nevar/nevok (Torres)
Kava	Kava plant	*Piper methysticum*	-
Lemon*	Lemon Tree	*Citrus limon or Citrus latifolia?*	-
Mandarin*	Mandarin Tree, Mandarin Orange	*Citrus reticulata*	-
Mango*	Mango Tree	*Mangifera indica*	-
Natongtong	Tall-stilt Mangrove	*Rhizophora apiculata*	Drongraf (Vilavi), natong beta/Narong ne bos (Malekula)
Nakatambol	Dragon Plum	*Dracontomelon vitiense*	Taparau/taperau (Aniwa/Futuna), Katambol (Ambae), inhuri (Aneityum), rau/neie/were (Banks), narau (Efate), chu/botlau/narau (Epi), hatabola (Maewo), narambol/netapol/nahu/katambol (Malekula), e-au (Paama), ghatambola/hatapola/katbol beda/katbol bini/katbol kabi/arbol (Pentecost), namal/mal/atopol/vihatobola/hatabola (Santo), tavarau/narah (Shepherds), nuwul/nunul/nakatambo (Tanna)
Nakavika	Malay Apple	*Syzygium malaccense*	Ghavika/kavika (Aniwa/Futuna), nakavika (Ambae), inyehegh (Aneityum), kvavika/nagveg/vigige (Banks), nakavika/nakafika/kafika (Efate), sefso/nika/purkaukau (Epi), weve (Erromango), ghabrha (Maewo), naravik/navi/ravigor (Malekula), ahi (Paama), ghavika/kavik maruh/kavik tememe (Pentecost), naghavira/vuhaviga/kevika/ne/ vihaviha (Santo), kavika/nakavika (Shepherds), nangavi/nagnawi/ nikaouk/ningarung/negavung (Tanna), neveviker/negebike (Torres)
Namalaus	Garuga	*Garuga floribunda*	Namalaus (Epi)
Namambe Tree	Tahitian Chestnut	*Inocarpus fagiferus*	Eifi/ivi/mambe (Aniwa/Futuna), ngwangwe (Ambae), inmap (Aneityum), maki/namak (Banks), ifi (Efate), ya/botnai/purgni (Epi), nowane/nowanei (Erromango), mabwei (Maewo), nais/nees/nies (Malekula), e-as (Paama), mabwe/mambwe/mamboa/mamba/maba/mop (Pentecost), natalise/talis/mape/vimape (Santo), ifi (Shepherds), naouk/nawuk/nowu (Tanna), nemek (Torres)
Nandao	Pacific Lychee	*Pometia pinnata*	Dau/tawa (Aniwa/Futuna), ndao (Ambae), netva (Aneityum), natwen/tewen (Banks), natau/nandau/tava (Efate), cha/botsau/classa/pura classa (Epi), tau (Erromango), dalaoa/dalaoua (Maewo), nandau/ndra/va/ra (Malekula), ara (Paama), ndau/lislis da/lislis temit (Pentecost), natoria/vunsaria/auo/eserie/virau (Santo), tava/nato (Shepherds), natum/nuwul/netem/narumi (Tanna), nevaramek (Torres)
Nangai	Nagali Nut	*Canarium indicum*	Gai/nai (Aniwa/Futuna), angai (Ambae), ngarda (Banks), nangi (Efate), fungi/botngi/ngi (Epi), bosoa/bwatirhambatua (Maewo), ningai/ningie/nenga/nenga esets (Malekula), inga/angai/ngi/nanghai/weknga balbal/waknga twewep (Pentecost), nangi/nangai/wawsi/anga (Santo), angai/na-anga (Shepherds)
Narara	Indian Coral Tree	*Erythrina variegata*	Narara (Epi)
Navele Tree	Cutnut	*Barringtonia edulis*	Navel Tree
Naviso	Naviso	*Saccharum edule*	Naviso/pitpit/naeve (Epi), nateuv (Malekula)
Naus*	Amberella	*Spondias dulcis*	Navi (Aniwa/Futuna), uji (Ambae), namal (Aneityum), nei/nur (Banks), namale (Efate), melmel/botmelmal/puru melmel (Epi), nevi (Erromango), isa (Maewo), nouncs-imel/naus/naus borton (Malekula), malimal (Paama), uhigai/barusvijic (Pentecost), ousi/nue/viusi (Santo), vi (Shepherds), nuk (Torres)
Aranis*	Orange tree	*Citrus aurantium*	Namolie (Santo)
Pawpaw*	Papaya	*Carica papaya*	-
Wael Ken	Wild Cane	*Potentially Miscanthus floridulus*	-
Yam*	Yam	*Dioscorea nummularia (Wild Yam) or D. alata*	-

Traditional Knowledge and Climate

Traditional knowledge is used throughout Vanuatu to forecast climate events, such as when the cyclone season will start and how active it will be, when the dry season will start and when to expect the wet season. This advance warning allowing community members to prepare for the upcoming season. In this section, three climates 'seasons' are considered:

- The cyclone seasons
- The wet season
- The dry season

Climate information for each season is provided together with traditional forecasting knowledge associated with this season. Traditional stories are provided together with information on how climate influences the species behaviour, for plants and animals, or physical appearance, for meteorological and astronomical indicators.

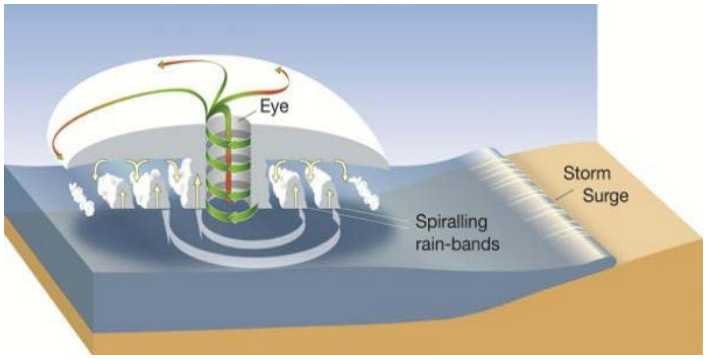


Tropical Cyclone Information

Tropical Cyclone season in Vanuatu is from November to April the following year.

Tropical cyclones are low-pressure systems that form over warm tropical waters. They typically form when the sea-surface temperature is above 26.5°C. Tropical cyclones can continue for many days, even weeks, and may follow quite erratic paths. A cyclone will dissipate once it moves over land or over cooler oceans.

Tropical cyclone is dangerous because they can produce extreme winds, heavy rainfall with flooding and damaging storm surge that can cause inundation of low-lying coastal areas.



Cyclones have **gale force winds** with wind gusts in excess of 90 km/h around their centre. In the most severe cyclones, gusts can exceed 280 km/h. These winds can cause extensive property damage and turn airborne debris into potentially lethal missiles. It is important to remember when the eye of a cyclone passes over a location, there will be a temporary lull in the wind, but that this will soon be replaced by destructive winds from another direction.

Heavy rainfall associated with the passage of a tropical cyclone can produce extensive flooding. This can cause further damage. The heavy rain can persist as the cyclone moves inland and weakens into a low-pressure system, hence flooding due to an ex-tropical cyclone can occur a long way from where the cyclone made landfall.

Storm surge are caused by extreme onshore winds from tropical cyclone that can cause the sea to rise well above the highest tide levels of the year when it comes ashore and also reduce atmospheric pressure.

The severity of a tropical cyclone is described in terms of categories ranging from 1 (weakest) to 5 (strongest) related to the maximum mean wind speed as shown below with pictures that can help to understand how strong the wind will be and the impacts that it can cause inland and how the sea state will be. The Vanuatu Tropical Cyclone Tracking Map is a useful tool.

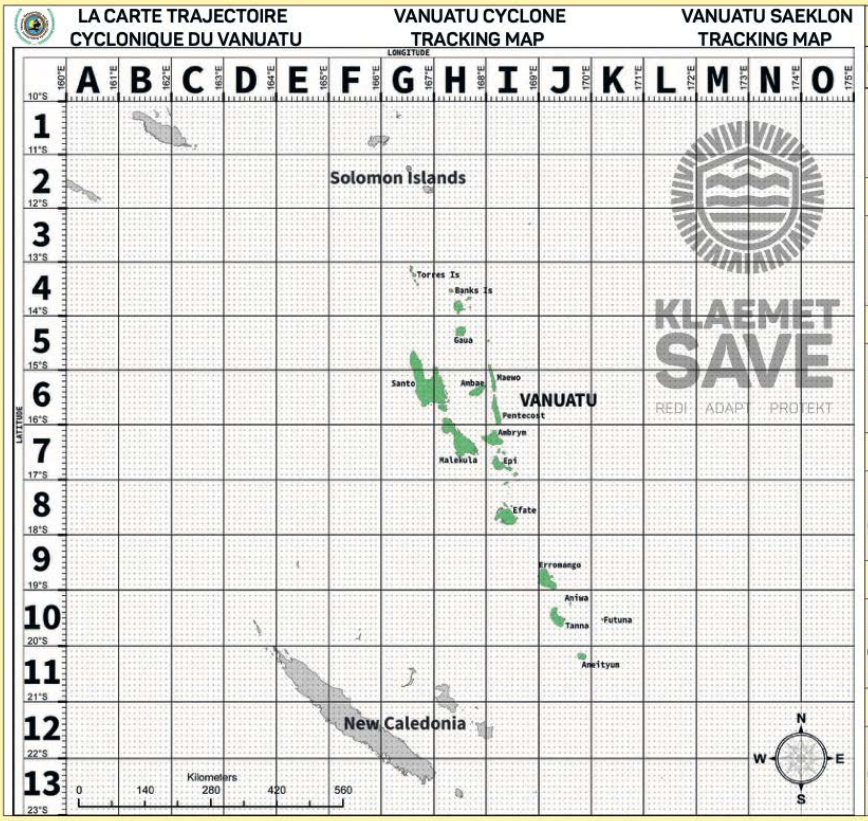
Where to access the information concerning tropical cyclones and weather
Check updates on Tropical cyclone 5 days' outlook, Tropical cyclone information, advisory or warning and other severe weather warnings at the following places;

- Website: www.vmgd.gov.vu
- Telephone: 22932/33632
- Free Toll Number: 116
- All Vanuatu radio stations

Preparing for the Cyclone Season
A cyclone is a type of natural disaster which consists of storms and a system of winds that rotates about the centre of low atmospheric pressure that bring great deal of rain. In Vanuatu cyclones are a regular subject that happen every year from November to April. Almost every community in the country have built up a strong resilience to natural disaster from past experience in which communities have practices that allow them in manage cyclone issues.
To be prepared for cyclone season NDMO Vanuatu has a cyclone Support Plan that documents the roles and responsibilities for the Government line ministries and partner agencies.
The main ways of preparing for the cyclone are:

- Be aware of the Cyclone Tracking Map

- Knowing the different national alerts such as blue, yellow and red to stay indoors
- Regularly listen to the radio for any cyclone updates
- Get an emergency kits ready, also includes all your important documents (Eg: passport, birth certificate, etc.)
- Prepare shelter, food, firewood, water container, warm clothes and other materials that could help you survive after the cyclone have passed



Rivaes long manis Octoba 2020: VMGD

KATEGORI	SPID BLONG WIN (kt, km/h)	KONDISEN LONG KRAON
Tropikol Lo STRONG WIN	25kt - 33kt, 46-62km/h	
Kategori 1 KEL FOS	34kt-47kt, 63-87km/h	
Kategori 2 STOM FOS	48kt-63kt, 88-117Km/h	
Kategori 3 HARIKEN FOS WIN WE I SAVE MEKEM DAMEJ	64kt-89kt, 118-165km/h	
Kategori 4 HARIKEN FOR WIN WE I SAVE MEKEM BIGFALA DAMEJ	90kt-114kt, 166-211km/h	
Kategori 5 HARIKEN FOS WIN WE I DENARES TUMAS	> 115kt > 212km/h	

Rivaes long manis Octoba 2020: VMGD

KATEGORI	WANEM DAMEJ SAEKLON I SAVE MEKEM LO KRAON	KONDISEN BLONG SOLWOTA	WANEM I SAVE HAPEN LONG SOLWOTA
Tropikol Lo STRONG WIN	[Tropikol Lo] Gat damej long olgeta smolsmol haos kasem olgeta natangura haos mo sam kakae long karen olsem olgeta banana tri. Saon blong win taem hemi blo long rop blong elektrik mo telefon waea, evri tri oli muv. I gat strong win blong 37 – 62 km/h ova long olgeta eria we oli flat.		Olgeta bigfala wev oli stat blong fom, olgeta waet fom oli kavremap bigfala eria taem wev hemi brok. Win i bloemaot olgeta waet fom ia folem daereksen blong we hemi blo ko long hem.
Kategori 1 KEL FOS	[Tropikol Saeklon] Olgeta yang branj blong olgeta tri oli brok. I gat smolsmol damej – olgeta ruf bae oli kamaot smol, olgeta bigfala branj bae oli brok. Olgeta kakae long karen bae oli damej. Ol Win blong wan Kategori 1 Tropikol Saeklon hemi KEL we oli gat strong win blong 63 – 87 km/h ova long eria we oli flat.		Olgeta wev oli ha emo longfala, i gat tik laen blong fom
Kategori 2 STOM FOS	[Tropikol Saeklon] Save damejem olgeta samting. Olgeta tri oli kamaot long kraon, bigfala damej long sam long olgeta plant. Bambae i save gat paoa kat. Ol Win blong wan Kategori 2 Tropikol Saeklon hemi ol STOM fos we oli save blo ova long wan flat eria long wan spid blong 125 – 169 km/h.		Bigfala hae wev we oli brok anta pi kam daon, we oli gat tik laen blong fom, olgeta we via oli foldaon m oi mekem ples i no kla gud blong lukluk
Kategori 3 HARIKEN FOS WIN WE I SAVE MEKEM DAMEJ	[Tropikol Saeklon we i strong tumas] Bae i gat damej long ruf mo bilding. Sam long olgeta tats haos bambae oli damej nogud. Bambae i save gat paoa kat. Ol Win blong wan Kategori 3 saeklon oli save mekem DAMEJ ova long olgeta flat eria wetem spid win blong 170 – 224 km/h.		Olgeta wev oli bigwan tumas, solwota hemi waet long olgeta fom, eya i fulap long olgeta fom mo spre blong solwota, ples i no klia nomo
Kategori 4 HARIKEN FOR WIN WE I SAVE MEKEM BIGFALA DAMEJ	[Tropikol Saeklon we i nogud tumas] Olgeta ruf bae oli flae aot mo olgeta bilding bae oli damej. Plante long olgeta tats haos bae oli distroe mo win bae hemi bloemaot olgeta. Win i save lefthemap olgeta pispis agan we i save mekem damej. Paoa i save kat. Ol Win blong wan Kategori 4 saeklon oli save mekem BIGFALA DAMEJ TUMAS ova long olgeta flat eria wetem spid blong win we hemi 225 – 279 km/h.		
Kategori 5 HARIKEN FOS WIN WE I DENARES TUMAS	[Tropikol Saeklon we hemi nogud tumas] Hemi denjares tumas mo i save mekem bigfala damej. Ol Strong win blong wan Kategori 5 oli DENJARES TUMAS ova long olgeta flat eria wetem wan spid blong win blong 279 km/h mo i go moa antap.		

OL NDMO WONING WE BAE I SAVE HELPEM YUMI PRIPEA

BLU ALET

VMGD i stap prediktim wan saeklon long 48 haoa taem – MAS PRIPEA

Taem oli putumaot BLU ALET, yu mas redi from se ol strong win bae i stat blong kam long 48 haoa taem.

- Mas onem mo lesin long ol infomeisen long Radio, TV o Intanet
- Lukaot mo stap longwei long ol toti aean mo ol toti, taetem gud ruf; priperem mo hangem ol saeklon shata
- Putum gud ol valuebol aetem mo ol impoten dokumen long wan wotapruf kontena o plastik bag
- Katem daon ol tri mo branj we i save mekem damej, katemaot ol lif blong ol banana mo ol maniok
- Priperem wan plan blong kipim ol animol blong yu i sef
- Priperem wota, kakae, toslaet, kandel, mases
- Meksua se fon i jaj mo i gat kredit
- Meksua se radio i on mo i gat spia bateri
- Aedentifaem ol ples long haos we i strong gud
- Determaenem evakueisen senta we i stap moa kolosap mo distens mo taem blong kasem ples ia
- Fulumap ol klos, ol meresin mo ol nara samting long wan evakueisen kit
- Sapotem famili mo ol neiba blong yu spesieli olgeta we i stap long nid long komiuniti blong yu

YELO ALET

VMGD i stap prediktim wan Saeklon long 36 haoa taem – MAS REDI MO MUV KWIK

Taem oli putumaot YELO ALET, yu nid blong tekem aksen from se ol Strong Win bae i stat blong kam long 36 haoa taem

- Mas lisen nomo mo karem infomeisen long Radio, TV, SMS o Intanet
- Yu mas mekem se ol pipol we yu lukaotem olgeta i mas stap tugeta inkludim ol pikinini blong skul
- Putum inaf fuel long ol trak mo putum olgeta long ples we i sef
- Putum ol bot long ol sef eria
- Instolem ol saeklon shata mo taetemap ol windo/ ol luva
- Faenalaesem evri BLU ALET aktiviti kwiktaem
- Putum mo kipim ol animol long ol sef ples
- Konsiderem distens mo taem we yu nidim blong kasem senta o sef ples mo muv eli sapos yu liv long wan haos o eria we i no sef
- Jekem gud bagegen evri wota, kakae, telefon, radio mo nara emejensi saplae
- Pispisim HF radio sistem mo putum long wan sef eria o long wota pruf kontena
- Sapotem famili mo ol neiba blong yu spesieli olgeta we i stap long nid long komiuniti blong yu

RED ALET

VMGD i stap prediktim se Saeklon long 24 haoa taem – STAP NOMO INSAED LONG HAOS O LONG WAN SEF PLES

Taem oli putum wan RED ALET, yu mas stap insaed long wan sef haos

- Mas lisen nomo mo karem infomeisen long Radio, TV, SMS o Intanet
- Ofem evri gas mo elektrisiti mo anplagem evri elektrikol aetem long ol paoa poen
- Mas stap nomo long ples we i strong mo i sef insaed long haos blong yu o evakueisen senta mo no mas go aotsaed.
- No mas stap kolosap long ol doa mo windo mo mas sarem mo lokem olgeta
- Stap nomo insaed long haos o long wan sef ples mo kontiniu blong lisen long radio mo no mas go aotsaed kasem taem we NDMO i putumaot "EVRITING I KLIA" afta we VMGD i kanselem saeklon woning long eria blong yu.
- Mas lukaot long ol denja we ol rop blong laet we i foldaon, ol tri, ol haos we i damej mo nara damej i save kosem
- Sapotem famili mo ol neiba blong yu spesieli olgeta we i stap long nid long komiuniti blong yu

OLGETA KONTAK INFOMESEN/ OLGETA IMENJENSI NAMBA	OLGETA NAMBA	ACCESS
VMGD ADMINISTRESEN	[678] 24686	OLGETA HAOA BLONG WOK
VMGD WETA FOKAS DIVISEN	[678] 22932, 33632 Tol Fri: 116	24/7
NDMO	[678] 22699	OLGETA OFISOL HAOA
POLIS	[678] 22222 Tol Fri: 111	24/7

Lisen long radio mo jekem SMS blong folem lokeisen blong Tropikol Saeklon long Traking Map.

OLGETA FRIKWENSI BLONG RADIO BRODKAS

STESEN	FRIKWENSI	TAEM	TAGET
RADIO VANUATU	MW 1125 KHZ	24 Hrs	SHEFA & TAFEA
	SW 7260 KHZ	08:00 - 17:30 Hrs	VANUATU
	SW 3945 KHZ	05:00 - 09:30 Hrs 16:30 - 23:30 Hrs	
	FM 100	24 Hrs	
CAPITAL FM107	FM 107 KHZ	24 Hrs	VANUATU
BUZZ FM	FM 96 KHZ	24 Hrs	PORT VILA
PARADISE FM [RADIO VANUATU]	FM 98 KHZ	24 Hrs	PORT VILA
HALO FM	FM 98.1	06:00 - 18:00 Hrs	TORBA, SANMA, PENAMA & MALAMPA
RADIO LIFE FM	FM 90	24 Hrs	PORT VILA

Traditional Cyclone Knowledge

There is much traditional knowledge about with the cyclone season. Here, we look at plants, animals, meteorological and atmospheric indicators used by traditional knowledge experts to forecast when the cyclone season is likely to start and how active it will be.

Sot Leg

Photo: JJ Harrison/Wikimedia Commons

OBJECT
Sot Leg

ACTION
Nesting low down

OUTCOME
Cyclone in a few months

English name	Pacific Emerald Dove
Scientific name	*Chalcophaps longirostris sandwichensis*
Local name(s)	Namahie (Santo)
Description	The Sot Leg, or Pacific Emerald Dove, is a squat ground-dwelling pigeon found in tropical and sub-tropical parts of Indonesia, Australia, and the western Pacific. It is found in all provinces of Vanuatu. The back and wings are emerald green. Flight is fast and direct, but it prefers to walk rather than fly. They are usually solitary but can be found in small groups.
Traditional knowledge	1. When the dove lays its eggs close to the ground a strong tropical cyclone is expected in a few months (Santo; Malekula) 2. When the dove nests very low in a bush or tree or near the ground a cyclone is expected in a few months' time (Epi, Santo) 3. Dove nesting at a lower height indicates the coming cyclone season (Pentecost) 4. When you see a dove no longer laying her eggs in the trees but laying them just at a very low height or even to the ground, it is for sure there will be a big, coming cyclone (Tanna)
Climate link	Sot Leg build their nests closer to the ground to avoid the powerful winds associated with cyclones.
Expected climate change response	Cyclones and stormy weather are likely to result in nests that are closer to the ground. Rainfall and temperature changes may change the timing of breeding and potentially impact on food availability for the Sot Leg.

Chicken

Photo: JJ Harrison/Wikimedia Commons

OBJECT
Chicken

ACTION
Sleeping in another location

OUTCOME
Cyclone strength/intensity

English name	Red Jungle Fowl /Domestic Chicken
Scientific name	*Gallus gallus /Gallus domesticus*
Local name(s)	Faol
Description	Red Jungle Fowl were brought to Vanuatu as part of the early human migration across the Pacific. The fowl bred with subsequent introduced chicken species and dispersed. Chickens are a good source of meat, feathers for decorations, and bones for fertilizer.
Traditional knowledge	When a cyclone warning is issued and the chicken are not going into their normal sleeping place, the TC category will increase (strong cyclone; Epi)
Climate link	Low barometric pressure often precedes storms that result in rainfall. It is believed that birds can sense pressure changes through their paratympanic organ, located in the middle ear. Changes in atmospheric pressure have been associated with behavioural changes in birds, including increased activity.
Expected climate change response	As temperatures warm, shade and additional food sources are likely to be required for chickens. Drought-adapted crops and fodder plants can be used as alternative feed sources. Extreme temperatures are likely to result in heat stress.

Frigatebird

Photo: NOAA

OBJECT
Frigatebird

ACTION
Flying inland

OUTCOME
Cyclone is approaching

English name	Lesser Frigatebird or Great Frigatebird
Scientific name	*Fregata ariel* or *Fregata minor*
Local name(s)	Nawuledibobo (Malekula)
Description	The Frigatebird is a bird that occurs over tropical and subtropical waters across the Indian and Pacific Oceans and the Atlantic coast of Brazil. They have long angular wings, deeply forked tails, and long, hooked bills. They are mostly seen soaring over the sea or coastline, occasionally descending to chase other fish-eating birds, scoop up marine organisms from the ocean surface, or taking flying fish just above the surface. The male is mostly black. During the breeding season, males have a large red sac of skin on the throat which they inflate during courtship displays. The breast of females is white, while head is black.
Traditional knowledge	1. When groups of birds, such as the Frigatebird, are seen flying inland it is a sign that a tropical cyclone is approaching (Epi) 2. If a flock of frigatebirds fly inland, inside the bay, it indicates a cyclone will come (Diverse Bay, Ureparapara) 3. When frigatebirds (Nawuledibobo) appear flying in the sky it indicates a cyclone will come. Always appear flying during the cyclone season (Malekula)
Climate link	Frigatebirds prefer not to fly over land. However, birds not at their colony fly higher and faster, avoiding the edge of the cyclone by using side winds allowing them to bypass the cyclone and this can cause them to stray over land. Birds may be able to use infrasound to perceive storms or cyclones up to 1000 km away, allowing them to make decisions in advance to avoid the event. They may also rely on current wind strength and direction as an indicator of the movement and heading of a storm.
Expected climate change response	Climate change is likely to lead to changings in the timing of nesting, changes in the breeding and feeding ranges, and changes in availability and abundance of food resources. Strong winds can damage breeding areas, cause mortality, and disrupt ocean foraging, as well as displace birds outside their normal range. Juvenile or young birds are more likely to be at risk of extreme events, as their behaviour during cyclones and storms differs from adults.

Flaengfis

Photo: NOAA/Wikimedia Commons

OBJECT
Flying Fish

ACTION
None caught

OUTCOME
Cyclone is approaching

English name	Flying Fish
Scientific name	*Exocoetidae* (species unknown)
Local name(s)	Flaengfis
Description	Most species of flying fish are found in tropical oceans. Their pectoral fins are greatly enlarged and allow them to glide above the water. They launch themselves out of the water at high speeds when they feel threatened.
Traditional knowledge	Flying fish are used as a sign of cyclones. An absence of flying fish caught by fishers is a sign of an approaching cyclone (Banks/Torres/Ureparapara).
Climate link	Abundance of flying fish has been related to chlorophyll-a concentration, sea-surface temperature and water depth.
Expected climate change response	Climate change is likely to lead to changings in the timing of spawning, changes in the breeding and feeding ranges, and changes in availability and abundance of food resources.

Flying Fox

Photo: Vanuatu Birding & Bird Photography

English name	Flying Fox
Scientific name	*Pteropus sp.*
Local name(s)	Flaengfokis
Description	Flying foxes are large bats that feed on fruit and flowers, including figs, bananas, breadfruit and coconuts. They are important for pollinating many plants, including food producing ones, and help to disperse seeds, particularly after cyclones.
Traditional knowledge	Flocks of flying fox at very low heights is a sign of an approaching cyclone. When it stops flying it means a big or severe cyclone is on the way (Tanna).

OBJECT
Flying Fox

ACTION
Flying low

OUTCOME
Cyclone is approaching

Climate link	Bat activity is strongly related to weather conditions. Flying fox tend to fly at lower heights (decrease soaring behaviour) during period of high humidity.
Expected climate change response	Climate change is likely to lead to changings in the timing of breeding and changes in availability and abundance of food resources. Extreme heat events can cause mass mortality in flying foxes.

Grin Totel

Photo: Brocken Inaglory/Wikimedia Commons

OBJECT
Grin Totel

ACTION
Nesting inland

OUTCOME
Cyclone season is approaching

English name	Green sea turtle
Scientific name	*Chelonia mydas*
Local name(s)	Grin Totel
Description	Grin Totel are found in tropical, subtropical and temperate regions of the world, including Vanuatu. They are the largest of the hard-shelled sea turtles often over 1m in length and weighing up to 230 kg. Their smooth shells are dark brown, grey or olive with lighter yellow to white undersides. Hatchlings are dark in colour with white edges on their bodies and flippers. Once mature, they forage in shallow coastal waters, mainly eating seagrass and algae. Every 2-5 years they return to the beach where they hatched to nest.
Traditional knowledge	1. When the turtle nesting area is very inland it is a sign that cyclone season is approaching. 2. If the turtle moves inland, it is indicating that a tropical cyclone is approaching (Nguna). 3. When the turtles come shore to tabu areas inside the forest that means a big cyclone will strike the island in the next 2-3 weeks (Tanna) 4. Turtle shows a lot of signs of a coming cyclone, and one of them is when the turtle comes ashore to lay its eggs in the sand, that shows that the indicator knows very well that the cyclone will be disturbing her eggs and for this reason she has to put her eggs in the sand. But if she does her nesting up in the bush that shows there will be a very strong cyclone and the sea will be rougher, for that reason she has to go up higher (Tanna)
Climate link	Nest site selection in sea turtles is influenced temperature, moisture, and salinity. Turtles can influence the duration of incubation and sex of hatchlings by selecting sites based on temperature. Nesting under trees results in cooler nests and reduces temperature fluctuations and reduces the risk of nest inundation and egg loss due to erosion.
Expected climate change response	Climate change is likely to alter beach morphology and increase sand temperatures. The ratio of male to female hatchlings is influenced by sand temperature. High sand temperatures can be lethal to turtle eggs. Rising sea levels and storm events may erode beaches and flood or wash away nests. Sea surface temperature changes may impact on the frequency and timing of sea turtle breeding.

Hoksbil Totel

Photo: Thierry Caro/Wikimedia Commons

OBJECT
Hoksbil Totel

ACTION
Nesting inland

OUTCOME

English name	Hawksbill sea turtle
Scientific name	*Eretmochelys imbricata*
Local name(s)	Hoksbil Totel
Description	Hoksbil Totel are found in tropical, subtropical and temperate regions of the world, including several nesting areas in Vanuatu. This totel has a parrot-like beak and narrow head. The shell is olive-green or brown with reddish-brown, brown or black markings in a tortoiseshell pattern. The shell is domed and heart-shaped with overlapping scales. Females weigh 60-80 kg and can grow up to 100 cm in length. The hatchlings are brown to black above and lighter underneath. Once they are 5-10 years old, they spend most of their time in tropical tidal and sub-tidal coral and rocky reef habitats. They eat many foods but prefer sea sponges. They lay 3-5 clutches of eggs per season.
Traditional knowledge	1. When the turtle nesting area is very inland it is a sign that cyclone season is approaching. 2. If the turtle moves inland, it is indicating that a tropical cyclone is approaching (Nguna). 3. When the turtles come shore to tabu areas inside the forest that means a big cyclone will strike the island in the next 2-3 weeks (Tanna)

Cyclone season is approaching

	4. Turtle shows a lot of signs of a coming cyclone, and one of them is when the turtle comes ashore to lay its eggs in the sand, that shows that the indicator knows very well that the cyclone will be disturbing her eggs and for this reason she has to put her eggs in the sand. But if she does her nesting up in the bush that shows there will be a very strong cyclone and the sea will be rougher, for that reason she has to go up higher (Tanna)
Climate link	Nest site selection in sea turtles is influenced temperature, moisture, and salinity. Turtles can influence the duration of incubation and sex of hatchlings by selecting sites based on temperature. Nesting under trees results in cooler nests and reduces temperature fluctuations and reduces the risk of nest inundation and egg loss due to erosion.
Expected climate change response	Climate change is likely to alter beach morphology and increase sand temperatures. The ratio of male to female hatchlings is influenced by sand temperature, more females are produced when temperatures are above 29 °C. High sand temperatures can be lethal to turtle eggs. Rising sea levels and storm events may erode beaches and flood or wash away nests. Sea surface temperature changes may impact on the frequency and timing of sea turtle breeding.

Leta Bak Totel

Photo: USFWS/Wikimedia Commons

OBJECT
Leta Bak Totel

ACTION
Nesting inland

OUTCOME
Cyclone season is approaching

English name	Leatherback sea turtle
Scientific name	*Dermochelys coriacea*
Local name(s)	Leta Bak Totel
Description	Leta Bak Totel are found in tropical and temperate regions of the world, small numbers nest in Vanuatu. The Leta Bak Totel grows up to 180cm long and weighs up to 500kg. The shell is made of soft leathery skin with seven ridges or keels. The colour is mostly black with differing amounts of pale spotting, including a pink spot on the heads of adults. It has no teeth and uses its sharp beak to catch food.
Traditional knowledge	1. When the turtle nesting area is very inland it is a sign that cyclone season is approaching. 2. If the turtle moves inland, it is indicating that a tropical cyclone is approaching (Nguna).
Climate link	Nest site selection in sea turtles is influenced temperature, moisture, and salinity. Turtles can influence the duration of incubation and sex of hatchlings by selecting sites based on temperature. Nesting under trees results in cooler nests and reduces temperature fluctuations and reduces the risk of nest inundation and egg loss due to erosion.
Expected climate change response	Climate change is likely to alter beach morphology and increase sand temperatures. The ratio of male to female hatchlings is influenced by sand temperature. High sand temperatures can be lethal to turtle eggs. Rising sea levels and storm events may erode beaches and flood or wash away nests. Sea surface temperature changes may impact on the frequency and timing of sea turtle breeding.

Honet

Photo: VMGD

OBJECT
Honet

ACTION
Nesting low

OUTCOME
Cyclone season is approaching

English name	Yellow Oriental Paper Wasp
Scientific name	*Polistes olivaceus*
Local name(s)	Honet
Description	The Hornet is native to India and East Asia and was introduced to the Pacific, including Vanuatu. The hornet is 18-24 mm in length with yellow antennae and legs and fine black patterning on the abdomen and thorax. Its nest is generally round and flat, often suspended from a solid, sheltered surface (often on buildings) or hidden in dense foliage.
Traditional knowledge	When Hornets' nest very low it is a sign that the cyclone season is approaching.
Climate link	Strong winds can carry wasps away from their nests. By nesting low, paper wasps reduced the chance of damage to their nests by strong winds.
Expected climate change response	Temperature increases due to climate change is likely to have a negative impact on the hornets' energetics and survival.

Palolo

Photo: Tina JZ Hango (Facebook)

OBJECT
Palolo

ACTION
Lots present

OUTCOME
Cyclone season is approaching

English name	Palolo Worm
Scientific name	*Palola viridis* or *Palola sicilensis*
Local name(s)	Palolo
Description	Palolo are found in tropical regions of Asia and the Pacific, including Vanuatu. Palolo are a type of bristle marine worm that grow up to 40 cm in length. Each segment of their bodies has paddle like appendages with gills. The head of the worm has many sensory tentacles. Males are reddish-brown and females are bluish-green. They live in crevices and coral rubble and breed at least twice per year. During this breeding season, the worms break in half with the tail section carrying the eggs or sperm to the surface. The tail section looks like an animal and has eyes and drifts on the waves in large, tangled masses. The head section remains in the reef.
Traditional knowledge	Heavy presence of palolo worms, more than previous time, is a sign that the cyclone season is approaching.
Climate link	Timing of the release is linked to annual (solar year), lunar, daily and tidal rhythm components. Sea surface temperature is likely to influence the abundance of Palolo. There is a link between El Niño and the quantity of palolo with strong El Niño's resulting in very low palolo harvests. More palolo seems to spawn in years of neutral El Niño.
Expected climate change response	Abundance of palolo expected to be reduced due to coral bleaching and high sea surface temperatures.

Banana

Photo: Paasikivi/Wikimedia Commons

OBJECT
Banana tree

ACTION
Many or large bunches

OUTCOME
Cyclone is approaching

English name	Banana (cultivar Gros Michel)
Scientific name	*Musa acuminata*
Local name(s)	Banana
Description	Bananas are widely distributed and cultivated throughout all Pacific Islands and are a major crop over most of Vanuatu. Bananas are herbs, the underground stem forming a false trunk. Bananas can be planted and harvested year-round.
Traditional knowledge	1. A heavy presence of banana trees bearing many/large bunches is a sign that a cyclone is approaching. 2. When banana bears much fruit, and also big in size, it is a bad sign of a cyclone is approaching (Tanna).
Climate link	High banana productivity is associated with moderately strong rainfall and temperatures in the range of 20-30°C.
Expected climate change response	Bananas are negatively impacted by cyclones and very strong winds as these can uproot the plants, tear leaves, and break off branches. Prolonged dry seasons can result in rotting of banana bunches and results in smaller bunches of fruit. Extended periods of very high temperatures damage plant tissue and distort the flower emergence and bunch filling. Heatwaves, when combined with drought, can result in slow development of bunches that do not ripen and fall to the ground.

Nabanga

Photo: Albert Willy, VMGD

OBJECT
Nabanga

ACTION
Lots of flowers

English name	Banyan tree, Strangler fig
Scientific name	*Ficus obliqua*
Local name(s)	Naowrevi (Aniwa/Futuna), Nerere (Aneityum), Narawaw (Efate), Lalaw (Epi), Narivrep (Erromango), Bliw and Nimbinank (Malekula), Rewerep (Pentecost), Bol (Santo)
Description	Nabanga is found throughout the tropical Pacific. It can grow up to 60m tall, with a similar width. It has a buttressed trunk of up to 3m in diameter and is used as traditional cyclone shelters. Each tree has both male and female flowers, with the male flowers maturing several weeks after the female ones. Nabanga sustain more wildlife than most other tree species and can speed up rainforest regeneration. They can live over 500 years.
Traditional knowledge	The presence of lots of flowering is a sign that the cyclone season is approaching.

OUTCOME
Cyclone season is approaching

Climate link	Female phases of the flowers can be present in any month, while male phases of the flowers are more likely to be present in warmer months.
Expected climate change response	Although Nabanga is highly resistant to cyclones, severe cyclones can still cause damage to the trees. Changes in rainfall and temperature may alter the timing and/or amount of flowering and fruiting.

Bredfrut

Photo: Petr Kratochvil/public domain

OBJECT
Bredfrut

ACTION
Lots of flowers and fruit

OUTCOME
Cyclone is approaching and it is going to be an active cyclone season

English name	Breadfruit tree
Scientific name	*Artocarpus altilis*
Local name(s)	Nape-ho (Santo)
Description	Although it is widely cultivated in the Pacific, Vanuatu is an important centre for bredfrut diversity, with 30-100 different cultivars found in northern Vanuatu. Bredfrut is an important food source post cyclones and other natural disasters.
Traditional knowledge	1. The presence of lots of flowering and lots of fruit is a sign it is going to be an active cyclone season. The greater the number of fruits, the stronger the cyclones. 2. The presence of lots of fruit is a sign that the cyclone season will occur in a few months. (Santo) 3. When the trees have more fruits (Navele, Nantao, Bredfrut) then cyclone or severe weather is expected in 2 to 3 months (Tanna). 4. When the breadfruit tree bears a lot of fruits, it is indicating a coming cyclone. When there are only few fruits it shows that there will be no cyclone. But when the branches are so heavy with the fruits then it is indicating a cyclone will be coming very soon (Tanna). 5. Fruit trees such as Bredfrut, Mango, and Pawpaw bearing many fruits indicates a category five cyclone will come (Ureparapara). 6. When bredfrut has its most flowers it indicates a cyclone (Pentecost).
Climate link	Warmer temperatures and good rainfall result in more flowers and fruit. Long dry periods cause fruit drop and smaller fruit.
Expected climate change response	Drought causes premature dropping of fruit, while storms, drought and salinity can cause trees to decline and dieback. Changes in rainfall are expected to alter flowering and fruiting patterns and higher temperatures may reduce the quality and quantity of fruit.

Burao

Photo: Vincenzo Defifoot/Wikimedia Commons

OBJECT
Burao

ACTION
Leaves are very green and the flowers are very yellow

OUTCOME
Cyclone season is approaching

English name	Beach Hibiscus
Scientific name	*Hibiscus tiliaceus*
Local name(s)	Fau (Aniwa/Futuna), Inhao (Aneityum), Varu/Nevei/Ver/Var (Banks), Orenavau (Erromango), Taru (Maewo), Balgo/Na teghvai/Nvava (Malekula), Voiave ali/Voiave ouhaha/Voiave tisa (Paama), Fae/Raava/Butsu raava (Pentecost), Navai (Santo), Nau (Tanna), Nevar/Nevok (Torres)
Description	The Burao tree is found throughout the tropics growing in at or near the coast or rivers. It can be used to stabilise the soil and as boundaries or windbreaks. The flowers are fragile and fall on the same day that they open. Flowering and fruiting can happen at any time of the year.
Traditional knowledge	When the leaves are heavily green, and the flower is more yellow, then it is a sign that a cyclone season is approaching.
Climate link	Light and temperature affect the number of leaves below the first flower. Increased temperature can delay flowering or increase the number of leaves.
Expected climate change response	High winds cause the trees to fall although they can continue to grow. Often growing near the ocean, it is threatened by sea level rise and coastal inundation. May experience delayed flowering under higher temperatures.

Kava

Photo: Scot Nelson/public domain

OBJECT
Kava plant

ACTION
Leaves become greener

OUTCOME
Cyclone season is approaching

English name	Kava
Scientific name	*Piper methysticum*
Local name(s)	Kava
Description	Kava was domesticated from a wild ancestor of Piper wichmannii in the north of Vanuatu and was later spread to all islands that Polynesian seafarers colonised. Kava is a source of income for many farmers. The Kava plant can be used to make a sedative or slightly intoxicating traditional drink sold ready to drink in Kava bars.
Traditional knowledge	When the leaves become greener it is a sign that the cyclone season is approaching.
Climate link	Kava leaves exposed to direct sunlight show a general yellowing on the upper surfaces that face the sun. When weather conditions are frequently overcast and wet, unshaded kava is greener.
Expected climate change response	Growth in kava plants is dependent on suitable temperatures, humidity, and soil composition, all of which climate change can impact.

Lemon

Photo: VMGD

OBJECT
Lemon tri

ACTION
Lots of flowers and fruit

OUTCOME
Active cyclone season

English name	Lemon or Persian/Tahiti lime
Scientific name	*Citrus limon* or *Citrus latifolia*
Local name(s)	Lemon tri
Description	Citrus trees are widely distributed and cultivated through the Pacific. They are small to medium-sized shrubs or trees valued primarily for their fruit but also used for traditional medicines, animal fodder, craft, and fuel.
Traditional knowledge	The presence of lots of flowering and lots of fruit is a sign that it is going to be an active cyclone season.
Climate link	Flowering is triggered by environmental conditions, including photoperiod, temperature, and plant-water stress. The number of flowers in one year is inversely proportional to the amount of fruit in the previous year. High day time temperatures with low humidity reduces growth.
Expected climate change response	Citrus trees are susceptible to damage due to strong winds. However, they generally have the least damage of all fruit trees during cyclones, due to a strong root system and wood grain resistance to twisting and shearing forces. More intense cyclone events may accentuate disease spread. Dry conditions result in smaller fruit, as well as grainy fruit and premature fruit drop. Dry conditions can also lead to root stress. Citrus do not tolerate waterlogged soils (root rot) and are sensitive to salt.

Mandarin

Photo: Linnaea Mallette/public domain

OBJECT
Mandarin

English name	Mandarin tree, Mandarin orange
Scientific name	*Citrus reticulata*
Local name(s)	Mandarin tri
Description	The Mandarin tree grows in the tropics and subtropics and is a recent introduction to the Pacific Islands. Flowering in mainly in spring but can occur at multiple times throughout the year. Citrus trees, such as the mandarin tree, support honey producing bees and can be used to moderate temperature near coffee crops.
Traditional knowledge	1. The presence of lots of flowering and lots of fruit is a sign that the cyclone season is approaching. 2. During the year when the fruit trees (breadfruit, mango, mandarin) have many flowers and fruits, it indicates a cyclone will come (Malekula).

ACTION
Lots of flowers and fruit

OUTCOME
Active cyclone season

Climate link	Fruiting and flowering are related to temperature. High temperatures during the flowering stage increases the abortion of fruit set in mandarin, due to negative effects of high temperature on type of inflorescences and growth of flower components. Temperatures around 15 °C produce more flowers than temperatures around 30 °C. Water stress releases bud dormancy as well as inducing flowering. High temperatures during bud sprouting increase the leafiness of the inflorescences and inhibit flowering. The longer fruit stays on the tree, the lower next year's flowering is. However, only when the number of flowers produced is too low or exceedingly high will flowering have a significant effect on the number of fruits produced.
Expected climate change response	Same as Lemon (above)

Aranis

Photo: Tony Rodd/CC BY-NC-SA 2.0

OBJECT
Aranis

ACTION
Lots of flowers and/or fruit

OUTCOME
Active cyclone season/cyclone is approaching

English name	Orange tree
Scientific name	*Citrus aurantium*
Local name(s)	Aranis, Namolie (Santo)
Description	Orange trees grow in the tropics and subtropics. It is a recent introduction to many of the Pacific Islands and has become naturalised in Vanuatu. It can have multiple flowering periods in the tropics, including year-round. It is a very good source of Vitamin C.
Traditional knowledge	1. The presence of lots of flowering and lots of fruit is a sign that it is going to be an active cyclone season. 2. The presence of lots of fruit is a sign that a cyclone will occur in a few months (Santo) 3. Orange trees with heavily beared flowers and fruits indicates a cyclone will come (Malekula).
Climate link	Seasonal flowering occurs after the winter months, usually after a stress event (water deficiency). Extreme events can disrupt the flowering and fruiting patterns. The presence of a high number of fruits reduces the flowering potential. Year to year temperature and rainfall variation during winter and spring is associated with variability in flowering intensity and yield.
Expected climate change response	Same as Lemon (above)

Mango

Photo: Mark Yang/public domain

OBJECT
Mango tree

ACTION
Lots of flowers and fruit

OUTCOME
Cyclone season is approaching, and it will be an active cyclone season

English name	Mango tree
Scientific name	*Mangifera indica*
Local name(s)	Mango tri
Description	Originally from India and Myanmar, the Mango Tree has become naturalised throughout the tropics and subtropics. Mango trees are large that can live for over 100 years. Most varieties flower once per year, producing dense clusters of flowers. The fruit is high in Vitamin A.
Traditional knowledge	1. The presence of lots of flowering and lots of fruit is a sign that the cyclone season is approaching and that it is going to be an active cyclone season. 2. During the year when the fruit trees (bredfrut, mango, mandarin) have many flowers and fruits, it indicates a cyclone will come (Malekula) 3. Fruit trees such as Bredfrut, Mango, and Pawpaw bearing many fruits indicates a category five cyclone will come (Ureparapara) 4. Mango flowering predicts the coming cyclone season. It is used to predict the number of events that are likely (Pentecost) 5. When you see a mango tree with very heavy flowering and the flowers cover the green leaves of the tree then it indicates a coming cyclone. Also, when the tree gives out lots and heavy fruiting, and the fruits bend down the tree branches, it indicates that the cyclone will surely come and break the tree branches down to the ground (Tanna).
Climate link	The Mango requires soil that dries out rapidly after the wet season, forcing the trees into a dormant period, essential for heavy flowering, however, dry conditions during fruit development results in very low yields. Continuous cloudiness from El Nino or la Nina can interfere with the tree's floral development.

Expected climate change response	Temperature is the primary influence on maturity timing, fruits growing faster and maturing earlier in warmer climates. The fruit yield is dependent on seasonal conditions. Observed climate variability has resulted in widespread changes in flowering and fruiting patterns. Anticipated higher temperatures could affect flowering. Mango production would be negatively impacted by an increasing intensity of cyclones.

Natongtong

Photo: Bernard Dupont/Wikimedia Commons

OBJECT
Natongtong

ACTION
Lots of flowers

OUTCOME
Active cyclone season

English name	Tall-stilt mangrove
Scientific name	*Rhizophora apiculata*
Local name(s)	Natongtong, Drongraf (Vilavi), Natong beta/Narong ne bos (Malekula)
Description	Mangroves are associated with wet, muddy and silty sediment. This species of mangrove has both aerial prop roots and stilt root which are designed to resist large waves and tropical storms. They are used to stabilise soil, to protect the coastline from storms, and to provide habitat for marine species. They also improve the water quality in nearshore environments. Parts of the plant can be used for traditional medicines and mangrove forests can be used as a sanctuary during cyclones.
Traditional knowledge	1. The presence of lots of flowering is a sign that it is going to be an active cyclone season. 2. When Drongraf, a specific type of mangrove grown along the coast of Uri Island and the Litzlitz coast, flowers and fruits it indicates an active cyclone season (Malekula).
Climate link	Increased temperature enhances flower production, the number of flowering events, the number of flowers compared to the number of immature buds, as well as the flowering periods. Flowering occurs mostly in the drier period leading up to the start of the wet season.
Expected climate change response	Mangroves are expected to respond rapidly and decisively to shifts in temperature, rainfall, and sea level. Their optimal temperature range is narrow, being most productive within the range 15–25°C. Temperatures over 25°C put thermal stress on roots and seedlings and at 38–40 °C the leaves stop photosynthesizing. Mangrove ranges are expected expand and contract according to groundwater availability. There is evidence that El Niño events and reduce growth in mangroves, most likely due to decreased freshwater availability. Warming temperatures and rainfall changes can alter the timing and amount of fruiting and flowering. Peak flowering and fruiting events shift later with cooler temperatures and higher latitudes.

Nakatambol

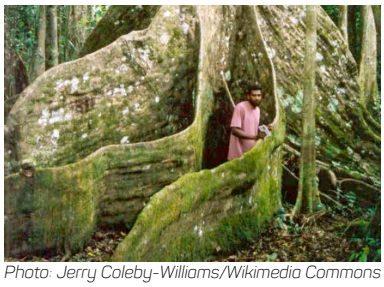


Photo: Jerry Coleby-Williams/Wikimedia Commons

OBJECT
Nakatambol

ACTION
Lots of fruit

OUTCOME
Cyclone season is approaching

English name	Dragon Plum
Scientific name	*Dracontomelon vitiense*
Local name(s)	Nakatambol, Taparau/taperau (Aniwa/Futuna), Katambol (Ambae), Inhuri (Aneityum), Rau/neie/were (Banks), Narau (Efate), Chu/botlau/narau (Epi), hatabola (Maewo), narambol/netapol/nahu/katambol (Malekula), e-au (Paama), ghatambola/hatapola/katbol beda/katbol bini/katbol kabi/arbol (Pentecost), namal/mal/atopol/vihatobola/hatabola (Santo), tavarau/narah (Shepherds), nuwul/nunul/nakatambo (Tanna)
Description	Nakatambol grows mainly in the Pacific and south-east Asia. It can grow up to 20m tall with buttresses. It can be used for food, medicine and for fuel.
Traditional knowledge	The presence of lots of fruit is a sign that the cyclone season will occur in a few months. (Santo; Epi)
Climate link	Lots of flowering and fruit of Nakatambol show the sign of an approaching cyclone and a season of wet in which the temperature is high and causes rainier or wet weather.
Expected climate change response	Changes in climate may change the timing and number of flowers and fruit.

Namambe

Photo: VMGD

OBJECT
Namambe tree

ACTION
Lots of flowers and fruit

OUTCOME
Active cyclone season

English name	Tahitian Chestnut, Polynesian Chestnut
Scientific name	*Inocarpus fagifer*
Local name(s)	Eifi/ivi/mambe (Aniwa/Futuna), ngwangwe (Ambae), inmap (Aneityum), maki/namak (Banks), ifi (Efate), ya/botnai/purgni (Epi), nowane/nowanei (Erromango), mabwei (Maewo), nais/nees/nies (Malekula), e-as (Paama), mabwe/mambwe/mamboa/mamba/maba/mop (Pentecost), natalise/talis/mape/vimape (Santo), ifi (Shepherds), naouk/nawuk/nowu (Tanna), nemek (Torres)
Description	The Namambe tree is believed to be indigenous to Vanuatu. It is an evergreen tree with a large dense canopy and short irregular buttresses. The flowers are fragrant and white to pale yellow. They are pollinated by bees and bats, fruit bats also spreading the seeds. Fallen fruit and seeds can be used in fish farming as food for freshwater fish and prawns. Four types of Namambe are found in Vanuatu and can be distinguished by the fruit shape and colour.
Traditional knowledge	The presence of lots of flowering and lots of fruit is a sign that it is going to be an active cyclone season.
Climate link	The presence of lots of flower and fruit in Namambe tree give a clear sign that a particular cyclone is approaching and this causes the tree to nourished and bear more fruits during hot season.
Expected climate change response	This species does not tolerate prolonged droughts. Warming temperatures and rainfall changes are expected to alter the timing and amount of fruiting and flowering.

Nandao

Photo: Forrest and Kim Starr/CC BY 2.0

OBJECT
Nandao tri

ACTION
Lots of flowers and fruit

OUTCOME
Active cyclone season

English name	Pacific Lychee
Scientific name	*Pometia pinnata*
Local name(s)	Dau/tawa (Aniwa/Futuna), ndao (Ambae), netva (Aneityum), natwen/tewen (Banks), natau/nandau/tava (Efate), cha/botsau/classa/pura classa (Epi), tau (Erromango), dalaoa/dalaoua (Maewo), nandau/ndra/va/ra (Malekula), ara (Paama), ndau/lislis da/lislis temit (Pentecost), natoria/vunsaria/auo/eserie/virau (Santo), tava/nato (Shepherds), natum/nuwul/netem/narumi (Tanna), nevaramek (Torres)
Description	Native to Vanuatu, the Nandao grows in secondary forest up to 300 m in altitude. There are several varieties, ranging from a small to very large tree. Older trees have prominent buttresses. Parts of the tree are used as traditional medicines.
Traditional knowledge	1. The presence of lots of flowering and lots of fruit is a sign it is going to be an active cyclone season. 2. When the trees have more fruits (Navele, Nantao, Bredfrut) then cyclone or severe weather is expected in 2 to 3 months (Tanna). 3. When the Nandao fruit Tree starts making flower it is indicating a coming cyclone (Tanna).
Climate link	Flowers following short periods of low temperatures and dry spells. Some varieties require stronger drought signals. Reproductive events are generally irregular and are often associated with ENSO events.
Expected climate change response	This tree is sensitive to extended dry seasons and does not like saltwater spray or temporary saltwater inundations. It is moderately resistant to cyclonic winds. It is often one of the first trees to grow after a cyclone.

Nangai

Photo: VMGD

English name	Nagali Nut, Galip Nut, Canarium Nut
Scientific name	*Canarium indicum*
Local name(s)	Gai/nai (Aniwa/Futuna), angai (Ambae), ngarda (Banks), nangi (Efate), fungi/botngi/ngi (Epi), bosoa/bwatirhambatua (Maewo), ningai/ningie/nenga/nenga esets (Malekula), inga/angai/ngi/nanghai/weknga balbal/waknga twewep (Pentecost), nangi/nangai/wawsi/anga (Santo), angai/na-anga (Shepherds)
Description	This species is found mainly in the northern and central regions of Vanuatu. The flowering period is very short, less than two weeks, while the fruiting period is long, at least six months. Nangari can be used as a shade tree, a windbreak, as well as for food and medicine.

OBJECT Nangai	
ACTION Lots of fruit	
OUTCOME Cyclone expected in a few months	
Traditional knowledge	The presence of lots of fruit is a sign that a cyclone will occur in a few months' time.
Climate link	Productivity in a season varies from tree to tree. Fruiting and flowering period varies by latitude (potentially day length driven) but is poorly understood. Cyclones in the previous year can lead to earlier flowering in the following year. Breaking off branches, including via cyclones, encourages new growth and flowering.
Expected climate change response	Cyclone stress reduces the proportion of sterile nuts. It has a good tolerance of strong and steady winds. Unlikely to tolerate long droughts.

Naus

Photo: Loupok/CC BY-NC-ND

OBJECT Naus	
ACTION Lots of flowers and fruit/heavy fruiting	
OUTCOME Cyclone season is approaching/stronger cyclones	
English name	Polynesian vi-apple, Tahitian apple, Hog plum
Scientific name	*Spondias dulcis*
Local name(s)	Navi (Aniwa/Futuna), uji (Ambae), namal (Aneityum), nei/nur (Banks), namale (Efate), melmel/botmelmal/puru melmel (Epi), nevi (Erromango), isa (Maewo), nouncs-imel/naus/naus borton (Malekula), malimal (Paama), uhigai/barusvijic (Pentecost), ousi/nue/viusi (Santo), vi (Shepherds), nuk (Torres)
Description	Naus is a medium sized tree with four to eight small buttresses and a rounded crown. In Vanuatu, there is greater variability between forms of this species than anywhere else, and villagers distinguish between different types of this species according to the size, colour and taste of its fruits. Naus loses its leaves during the dry season.
Traditional knowledge	The presence of lots of flowering and lots of fruit is a sign that cyclone season is approaching and that it will be an active cyclone season. Heavy fruiting indicates stronger cyclones.
Climate link	Fruiting timing depends on the time of flowering and climate conditions. Naus sheds it's leaves during the cooler months and mature trees generally start to flower and fruit with the flush of new leaves.
Expected climate change response	The fruit of Naus are not very resistant to strong winds and cyclones, falling before they are ripe. Climate change is expected to alter the size, quantity, and quality of the fruit.

Navele

Photo: Arthur Chapman/Flickr

OBJECT Navele tree	
ACTION Lots of flowers and/or lots of fruit	
OUTCOME Cyclone season is approaching. Active cyclone season	
English name	Cut nut
Scientific name	*Barringtonia edulis*
Local name(s)	Navele
Description	The Navale is endemic to the Solomon Islands, Vanuatu and Papua New Guinea. It is a medium sized tree with a vigorous framework of branches. The 'flowers' are part of a long hanging spike with over 100 densely packed flower buds, arranged in a spiral pattern. Almost every part of the plant has a traditional use.
Traditional knowledge	1. The presence of lots of flowering and lots of fruit is a sign that a cyclone will occur in a few months' time, and it is going to be an active cyclone season. 2. The presence of lots of fruit is a sign that a cyclone will occur in a few months' time, and it is going to be an active cyclone season (Santo) 3. When the trees have more fruits (Navele, Nantao, Bredfrut) then cyclone or severe weather is expected in 2 to 3 months (Tanna) 4. When the fruit tree starts giving out its heavy flowerings it is indicating a cyclone season is coming (Ureparapara)
Climate link	Timing of fruiting and flowering varies by latitude. Flowers and fruits either throughout the year or several times per year.
Expected climate change response	Navele is likely to be intolerant to prolonged droughts and to increased saltwater contact. It has a medium to high tolerance to strong winds, including cyclones. Changes in the quality and quantity of fruit.

Pawpaw

Photo: VMGD

OBJECT
Pawpaw

ACTION
Lots of flowers and fruit

OUTCOME
Active cyclone season is approaching

English name	Papaya, pawpaw
Scientific name	*Carica papaya*
Local name(s)	Pawpaw
Description	Pawpaw is an introduced species to Vanuatu, but it now commonly occurs in gardens and villages. It is a shrubby tree with scented trumpet-shaped yellow or cream flowers. Seeds are spread by Common Mynahs and fruit bats. Pawpaw is recommended to eating by young children as it is easy to digest and contains vitamins A, C, and potassium.
Traditional knowledge	1. The presence of lots of flowering and lots of fruit is a sign that the cyclone season is approaching, and it is going to be an active cyclone season. 2. During the year when the fruit trees (bredfrut, mango, mandarin) have many flowers and fruits, it indicates a cyclone will come (Malekula). 3. Fruit trees such as Bredfrut, Mango, and Pawpaw bearing many fruits indicates a category five cyclone will come (Ureparapara).
Climate link	Flowering is negatively related to high temperatures and is influenced by rainfall.
Expected climate change response	Excessive moisture in the soil leads to root rot. Pawpaw is vulnerable to cyclones. Warming temperatures and rainfall changes are expected to alter the timing, quality, and amount of fruiting and flowering.

Wael Ken

Photo: Wikimedia Commons

OBJECT
Wael Ken

ACTION
Flowering

OUTCOME
Active cyclone season

English name	Wild Cane
Scientific name	*Miscanthus sinesis* or *Miscanthus floridulus*
Local name(s)	Wael ken
Description	Wael Ken grows in clumps and used as a traditional building material. The cane can also be used to drink kava once the pith is removed.
Traditional knowledge	The presence of flowers is a sign that it is going to be an active cyclone season. (Epi)
Climate link	Flowering linked to rainfall, degree days and mean temperature. Mild periods of water deficit may delay flowering. Flowers earlier in warmer years for some genotypes.
Expected climate change response	Does not tolerate a high salt content in the soil. Changes in the timing of flowering and growth patterns.

Yam

Photo: Tau'olunga/Wikimedia Commons

OBJECT
Yam

ACTION
Green vines growing upwards

English name	Yam
Scientific name	*Dioscorea nummularia* (Wild Yam) or *D. alata*
Local name(s)	—
Description	There are over 600 species of yam, six of which are eaten in Vanuatu, four commonly so. It is possible to distinguish the yam species by the direction in which their vines climb up stakes (to the left or right), the presence or absence of spines, aerial tubers, and leaf shape. Yam plants have underground tubers, which are used to store starch. Shoots grow out from the tuber during the wet season. The old tuber dies, and new tubers are formed. The plant is dormant during the dry season.
Traditional knowledge	Presence of yam vines growing up on their bed and becoming green is a sign that it is going to be an active cyclone season.
Climate link	Yams do not grow well if the temperature is below 20°C, preferring temperatures in the range of 25-30°C. It requires moisture to grow, with active growth (including sprouting) occurring during the wet season and dormancy during the dry season. Wetter periods can result in more growth.

OUTCOME Active cyclone season	**Expected climate change response**	Increased temperature can cause crops to wilt and a decline in yield quality (smaller tubers, lower survival rates, changes in taste and abnormal fruit shape). Drought is likely to exacerbate this. Young crops are likely to be scorched by high temperatures and growth stunted. Permanent wilting can lead to plant death. Excessive rainfall can cause root rot and the yam to lose its flavour, probably through rainfall increases causing nitrogen leaching. The Wild Yam is a hardy species and tolerates drought and a prolonged wet season.

Beaches

OBJECT Beach	**English name**	Beach
	Local name(s)	Sanbij
ACTION Lots of sea dirt	**Traditional knowledge**	Heavy presence of sea dirt is a sign that it is going to be an active cyclone season (Malekula).
	Climate link	Lost of sea dirt related to the sign of cyclone season, the higher the air temperature is the more the sea gets hotter which creates more dirt along the beach.
OUTCOME Active cyclone season	

Air temperature

OBJECT Air temperature	**English name**	Air temperature
	Local name(s)	Aea tempretja
ACTION Hot temperatures	**Traditional knowledge**	1. When the air becomes hotter it is a sign that a cyclone is approaching 2. When day and night temperatures are very high then it is a sign that the cyclone season is approaching (Epi) 3. When there are high temperatures over a short period of time then it is it is a sign that the cyclone season is approaching, and it is going to be an active cyclone season (Santo) 4. Atmospheric air on the mountain was hot. When the air gets too hot and the clouds covered the sky or air but still the atmosphere was hot then we know that there will be a coming cyclone. In some places, where creeks are gets dry if it still getting hot, this indicates that a big cyclone will be coming and will clean up the creeks, and also will break off some of the tree branches so that the fruit trees will bear good flowerings and fruits in its right season (Tanna)
	Climate link	When the temperature gets higher and hotter the mountain also gets hot which leads to rainfall and wet season then later leads to cyclone season.
OUTCOME Cyclone season is approaching and/or it will be an active cyclone season	

Clouds

OBJECT Clouds	**English name**	Clouds
	Local name(s)	Ol klaod
ACTION Covering cave entrance (Tanna), very red at hillside (Epi), quickly change from orange to red (Santo), lots of clouds – including lower ones	**Traditional knowledge**	1. The presence of cloud covering the entrance of the secret cave in Tanna it is a sign that a cyclone is approaching, and it is going to be an active cyclone season (Tanna) 2. When it is very red at the hillside it is a sign that it is going to be an active cyclone season (Epi) 3. When the clouds turn orange to red over a short period of time then it is a sign that the cyclone season is approaching (Santo) 4. Heavy presence of clouds in the sky is a sign that a cyclone is approaching 5. Heavy presence of cloud lower and covering the mountains is a sign that it is going to be an active cyclone season 6. When the yellow cloud forms in the West of the Island when the sun starts to sets, it is indicating that a cyclone is coming after 4 weeks/1 months (Diverse Bay, Ureparapara)
	Climate link	When the temperature gets high and hot it creates dark black clouds up the air that form rainfall that further leads to cyclone time.
OUTCOME Cyclone season is approaching and/or it will be an active cyclone season	

Moon

OBJECT
Moon

ACTION
Moon movement from north to south

OUTCOME
Cyclone season is approaching and it will be an active cyclone season

English name	Moon
Local name(s)	Mun
Traditional knowledge	The presence of moon movement and the direction is from north to south is a sign that a cyclone is expected in a few months' time, and it is going to be an active cyclone season
Climate link	The movement of moon from north to south is the sign the cyclone season is approaching.

Rain

OBJECT
Rain

ACTION
Continuous rain, darkness

OUTCOME
Active cyclone season

English name	Rain
Local name(s)	Ren
Traditional knowledge	Continuous rain with the place becoming darker is a sign that it is an active cyclone season (Epi)
Climate link	When the rain is raining non-stop with a dark sign during daylight it shows that there will be a cyclone season soon.

Ocean

OBJECT
Ocean

ACTION
Very rough

OUTCOME
Cyclone season is approaching

English name	Ocean
Local name(s)	Solwota, Osen
Traditional knowledge	1. Very rough seas are a sign that a cyclone and the cyclone season are approaching (Epi) 2. Sea Waves, during the year when a big heavy high tide flow inside the bay of Uri, it indicates a cyclone will come (Malekula)
Climate link	When the temperature of the seas is change to very rough sea is a sign that cyclone season is approaching.

Sunset

OBJECT
Sunset

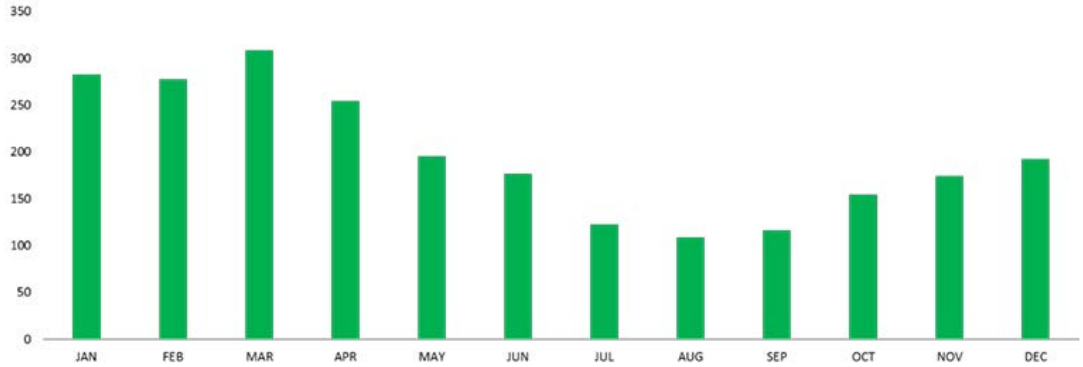
ACTION
Yellow cloud on the western side

OUTCOME
Active cyclone season expected in a few months

English name	Sunset
Local name(s)	Taem san i ko daon
Traditional knowledge	The presence of yellow cloud during sunsets at the western side is a sign that a cyclone is expected in a few months' time and it is going to be an active cyclone season
Climate link	Yellow cloud on the western side of the island shows that there will be an active cyclone season expected in a few months.


The Wet Season

Historical rainfall for all stations in Vanuatu – monthly average rainfall (mm) based on 30 years x data



Key Messages for Wet Season

- Wet season is also the cyclone season in Vanuatu
- It runs from November to April
- It is the 6-month period where we usually receive more rainfall
- The wettest months of the wet season are January, February, March
- During wet season, people are advised to prepare for cyclones and possible flooding

Wet season occurs during the season of cyclone which is from November to April in which covers almost 6 months. This period consists of many rainfalls and the wettest months of the season are January, February, and March. Therefore, during the wet season people are advised to prepare for any cyclone and other possible natural disaster that could occur such as flooding, landslide, and earthquakes.

Preparing for the Wet Season

The Wet season occurs regularly from the month of November to April, and consists of heavy rainfall and the cyclone season. This is where the dark cloud gets big and darker and later form rain and strong winds which can also called La Niño weather.
To prepare for this season people should:

- Build strong and high houses to protect from flooding
- Stock firewood and food, then cultivated crops that can grow during wet season
- Prepare emergency kits and important documents put it in a safe place
- Listen to radio and the department for any warning or advice given

Traditional Wet Season Knowledge

Nasiko

Photo: ebird.org

OBJECT
Nasiko

ACTION
Sings a lot

OUTCOME
Wet season is approaching

English name	Kingfisher
Scientific name	*Todiramphus chloris* , *Todiramphus farquhari*
Local name(s)	Nasiko, Napasohi (Santo)
Description	Two species of kingfisher are known as Nasiko in Vanuatu. *Todiramphus chloris* is native to Vanuatu. It is blue to green on the upper parts and has white or buff underparts. The neck has a white collar. The most common call is a loud harsh and metallic "kee-kee-kee", which is repeated many times. *Todiramphus farquhari* is a near-endangered, endemic, kingfisher found only in Espiritu Santo, Malo and Malekula in Vanuatu. It has a blue head, a white chest and neck, bright blue back and wings and orange underparts. It is very vocal with long series of chirping notes that rise in pitch and speed.
Traditional knowledge	When the napasohi sings a lot, it is a sign the wet season is approaching (Santo)
Climate link	Low barometric pressure often precedes storms that result in rainfall. It is believed that birds can sense pressure changes through their paratympanic organ, located in the middle ear. Changes in atmospheric pressure have been associated with behavioural changes in birds, including increased activity.
Expected climate change response	Change in the timing of egg laying. Changes in food availability and foraging patterns. Potential for further population decline.

Swallows and swiftlets

Photo: VMGD

OBJECT
Swallow/swiftlet

ACTION
Fly for a long time

OUTCOME
Wet season is approaching

English name	Swiftlet, Swallow
Scientific name	*Hirundo sp., Collocalia sp., Aerodramus sp.*
Local name(s)	Swallow
Description	The legs of these species are very short making it difficult for them to perch. Their wings are narrow which allows them to fly fast. This, together with their small beak surrounded by bristles, allows them to catch insects in flight. Their breeding season overlaps with the wet season when more insects are generally available.
Traditional knowledge	When flocks of swallows fly for an unusually long time it is a sign that the wet season is approaching.
Climate link	It is believed that birds can sense pressure changes through their paratympanic organ, located in the middle ear. Changes in atmospheric pressure have been associated with Climate link: behavioural changes in birds, including increased activity. Birds often increase foraging activity immediately prior to breeding.
Expected climate change response	Change in the timing of egg laying. Changes in food availability and foraging patterns.

Buluk

Photo: Law Partners

OBJECT
Buluk

English name	Cow, bullock
Scientific name	*Bos taurus or Bos indicus*
Local name(s)	Buluk, Napulu-ka (Santo)
Description	Cattle were originally introduced to Vanuatu to help keep the grass short in coconut plantations. Now, Vanuatu is one of the largest beef producers in the Pacific.
Traditional knowledge	1. If the bullocks (Napulu-ka) are excited/happy and jumping about then the wet season is approaching (Santo) 2. If the cows are agitated, then it is a sign the wet season is approaching (Epi)
Climate link	Warm-weather fronts, with low air pressure, can cause frustration and restlessness in cattle due to the drop in air pressure and increase in temperature and humidity.

ACTION
Excited, jumping or agitated

OUTCOME
Wet season is approaching

Expected climate change response	Drought combined with high temperatures is likely to cause thermal stress on plants, including those cattle depend, on as well as on the cattle. This is likely to impact on the health, productivity, and reproductive efficiency of the cattle. Increased rainfall can lead to increased spread and occurrence of pests and diseases.

Bat

Photo: V. Prié

OBJECT
Bat

ACTION
A Lots flying around:

OUTCOME
Wet season is approaching, rain will fall in a few hours

English name	Little bent-wing bat
Scientific name	*Miniopterus australis*
Local name(s)	–
Description	These bats roost in colonies in caves and tree hollows. They feed on small insects that fly beneath the canopy of thick forests. They need to be agile fliers to catch their prey. They are small and brown with a body length of around 45 mm.
Traditional knowledge	Heavy presence of the small bat flying around is an indicator that the wet season is approaching and that it will rain in a few hours' time (Epi).
Climate link	Increases in temperature and air pressure both increase bat activity. Temperature and humidity reach their highest annual levels and rainstorms begin before the tropical wet season. It is possible that the relatively abrupt changes in weather conditions at this time of year triggers an increase in bat activity, possibly as a result of reproductive activity. Warm nights also correspond to more bat activity. More bat activity is recorded during dark periods (less visible moonlight) and cloud cover associated with approaching rainfall would influence the darkness level.
Expected climate change response	Drought is likely to affect the bat's reproductive success and adult survival as a result of reduced water and prey availability.

Dog

Photo: VMGD

OBJECT
Dog

ACTION
Agitated

OUTCOME
Wet season is approaching

English name	Dog
Scientific name	*Canis lupus familiaris*
Local name(s)	Dok
Description	Dogs are part of village life in Vanuatu.
Traditional knowledge	If the dogs are agitated, then it is a sign the wet season is approaching (Epi)
Climate link	Dogs are sensitive and responsive to barometric pressure changes. Drops in atmospheric pressure are often followed by increase hostility and restlessness in dogs.
Expected climate change response	Like humans, dogs are likely to be affected by increased temperatures particularly during extreme heat waves. Increased temperatures and changes in rainfall patterns will also alter the abundance of pests and diseases.

Frog

Photo: Wikimedia Commons

English name	Green and Golden Bell Frog
Scientific name	*Litoria aurea*
Local name(s)	–
Description	A large ground-dwelling frog growing up to 11 cm in length. It has a bright green back with gold patches and a white belly, although it can be almost complete dark brown when inactive during the cooler months. Often active during the day, it can also be seen basking in the sun. Native to eastern Australia, this species was introduced to Vanuatu in the 19th century. It helps to control mosquitoes.

OBJECT
Frog

ACTION
Very noisy

OUTCOME
Wet season is approaching

Traditional knowledge	When the frogs are very noisy it is a sign that the wet season is approaching
Climate link	Frog species are known to call when the barometric pressure is low. Low barometric pressure often precedes storms that result in rainfall. Calling is also associated with increased humidity. In the warmer months the frogs move around searching for food and mates. In Australia, breeding peaks after heavy rainfall or storms.
Expected climate change response	Hydrological changes are likely to impact this species, including changes in flow and flooding regimes of streams and wetlands, as well as storm and flood events which result in increased salinity. Increased soil erosion and sedimentation is also likely to reduce the availability of suitable breeding sites.

Bebet

Photo: VMGD

OBJECT
Bebet

ACTION
Uncommon behaviours

OUTCOME
Wet season has started

English name	Insects
Scientific name	Various species
Local name(s)	Ol bebet, ol pepet
Description	Insects are a very important component of an ecosystem. Their roles including pollination and decomposition as well as being a food resource for birds and mammals.
Traditional knowledge	The presence of insects with uncommon behaviours is a sign that the wet season has started.
Climate link	As many insects are ectothermic, temperature is an important environmental variable that drives their behaviour. Metabolic rate, a key component of energy budgets, in ectotherms depends on temperature and body mass. In the tropics, where temperatures are more consistent throughout the year, wet and dry seasons drive the rhythmic variation in insects.
Expected climate change response	Climate change has seen an increase in some insect species (particularly warm adapted species) and a decline in others (predominantly cold adapted species). Extreme events are likely to impose stress on insect populations. Tropical insect species, especially small ones, are particularly sensitive to changes in rainfall and humidity.

Pig

Photo: VMGD

OBJECT
Pig

ACTION
Excited and jumping

OUTCOME
Wet season is expected

English name	Pig
Scientific name	*Sus domesticus*
Local name(s)	Napoeh (Santo), Picad
Description	The pig arrived in Vanuatu together with its first people. As such it is important socially, economically and culturally. Pigs are often associated with power and status.
Traditional knowledge	If the pigs (Napoeh) are excited/happy and jumping about then the wet season is expected. (Santo)
Climate link	Pigs are sensitive and responsive to barometric pressure changes and warm temperatures. Drops in atmospheric pressure and increases in temperature are often followed by increase hostility and restlessness in pigs.
Expected climate change response	Percentage of animals subjected to extreme heat stress is expected to increase. High temperatures cause pigs to increase respiration, decrease activity, reduce food intake, increase water intake. High temperatures and strong winds cause a stress response in pigs, prolonged exposure leading to agnostic behaviour and ultimately decreases in weight, fertility disorders and injuries. Extremely high temperatures cause heat stress, increased susceptibility to disease, and in extreme cases death.

Banana

Photo: Paasikivi/Wikimedia Commons

OBJECT
Banana tree

ACTION
Leaves turning yellow

OUTCOME
Wet Season is approaching

English name	Banana (cultivar Gros Michel)
Scientific name	*Musa acuminata*
Local name(s)	–
Description	Bananas are widely distributed and cultivated throughout all Pacific Islands and are a major crop over most of Vanuatu. Bananas are herbs, the underground stem forming a false trunk. Bananas can be planted and harvested year-round.
Traditional knowledge	Lots of banana leaves turning yellow is a sign that the wet season is beginning.
Climate link	High banana productivity is associated with moderately strong rainfall and temperatures in the range of 20-30 °C. High temperatures can cause the leaves to 'burn'.
Expected climate change response	Bananas are negatively impacted by cyclones and very strong winds as these can uproot the plants, tear leaves, and break off branches. Prolonged dry seasons can result in rotting of banana bunches and results in smaller bunches of fruit. Extended periods of very high temperatures damage plant tissue and distort the flower emergence and bunch filling. Heatwaves, when combined with drought, can result in slow development of bunches that do not ripen and fall to the ground.

Kava

Photo: Scot Nelson/public domain

OBJECT
Kava plant

ACTION
Leaves become greener

OUTCOME
Wet season is beginning

English name	Kava
Scientific name	*Piper methysticum*
Local name(s)	–
Description	Kava was domesticated from a wild ancestor of Piper wichmannii in the north of Vanuatu and was later spread to all islands that Polynesian seafarers colonised. Kava is a source of income for many farmers. The Kava plant can be used to make a sedative or slightly intoxicating traditional drink sold ready to drink in Kava bars.
Traditional knowledge	Greener leaves indicate the beginning of the rainy (wet) season.
Climate link	Kava leaves exposed to direct sunlight show a general yellowing on the upper surfaces that face the sun. When weather conditions are frequently overcast and wet, unshaded kava is greener.
Expected climate change response	Kava production varies according to seasonal conditions. Kava is sensitive to drought conditions.

Nakavika

Photo: Forest and Kim Starr/Wikimedia Commons

OBJECT
Nakavika

English name	Malay Apple
Scientific name	*Syzygium malaccense*
Local name(s)	Ghavika/kavika (Aniwa/Futuna), nakavika (Ambae), inyehegh (Aneityum), kvavika/nagveg/vigige (Banks), nakavika/nakafika/kafika (Efate), sefso/nika/purkaukau (Epi), weve (Erromango), ghabrha (Maewo), naravik/navi/ravigor (Malekula), ahi (Paama), ghavika/kavik maruh/kavik tememe (Pentecost), naghavira/vuhaviga/kevika/ne/vihaviha (Santo), kavika/nakavika (Shepherds), nangavi/nagnawi/nikaouk/ningarung/negavung (Tanna), neveviker/negebike (Torres)
Description	In Vanuatu the locals recognise four to six different forms of this plant, based on the colour, size and taste of the fruits. The flowers and fruits can be either pink or white, depending on the form present. The wood from this tree can be used to make canoes.
Traditional knowledge	Presence of flowers and/or fruit is a sign that the wet season is approaching (Epi).

ACTION
Flowers or fruit present

OUTCOME
Wet season is approaching

Climate link	Flowering is driven by climate and is commonly seen at the transition from the dry to wet season.
Expected climate change response	Extensive drought can cause significant leaf fall. Warming temperatures and rainfall changes can alter the timing and amount of fruiting and flowering.

Namalaus

Photo: Tau'olunga/Wikimedia Commons

OBJECT
Namalaus

ACTION
Flowers or fruit present

OUTCOME
Wet season is approaching

English name	Garuga
Scientific name	*Garuga floribunda*
Local name(s)	Namalaus (Epi)
Description	A large deciduous tree with a buttressed bole. It is valued for its timber and can also be used medicinally. The fruit is edible.
Traditional knowledge	Presence of flowers and/or fruit is a sign that the wet season is approaching (Epi).
Climate link	When the Namalaus tree pair more flowers that means the wet season is approaching.
Expected climate change response	Warming temperatures and rainfall changes are expected to alter the timing and amount of fruiting and flowering.

Namambe

Photo: VMGD

OBJECT
Namambe tree

ACTION
Flowering

OUTCOME
Wet season

English name	Tahitian Chestnut, Polynesian Chestnut
Scientific name	*Inocarpus fagifer*
Local name(s)	Eifi/ivi/mambe (Aniwa/Futuna), ngwangwe (Ambae), inmap (Aneityum), maki/namak (Banks), ifi (Efate), ya/botnai/purgni (Epi), nowane/nowanei (Erromango), mabwei (Maewo), nais/nees/nies (Malekula), e-as (Paama), mabwe/mambwe/mamboa/mamba/maba/mop (Pentecost), natalise/talis/mape/vimape (Santo), ifi (Shepherds), naouk/nawuk/nowu (Tanna), nemek (Torres)
Description	The Namambe tree is believed to be indigenous to Vanuatu. It is an evergreen tree with a large dense canopy and short irregular buttresses. The flowers are fragrant and white to pale yellow. They are pollinated by bees and bats, fruit bats also spreading the seeds. Fallen fruit and seeds can be used in fish farming as food for freshwater fish and prawns. Four types of Namambe are found in Vanuatu and can be distinguished by the fruit shape and colour.
Traditional knowledge	When Namambe starts giving out its flowers it is the wet season (Tanna)
Climate link	Wet season from November to April every year
Expected climate change response	This species does not tolerate prolonged droughts. Warming temperatures and rainfall changes are expected to alter the timing and amount of fruiting and flowering.

Navele

Photo: Arthur Chapman/Flickr

English name	Cutnut
Scientific name	*Barringtonia edulis*
Local name(s)	Navele
Description	Navele is native to the Solomon Islands, Vanuatu and Papua New Guinea. It is a medium sized tree that is commonly grown in home gardens and coconut plantations. Almost every part of this plant has a traditional use.
Traditional knowledge	Flowering very late in the season is a sign that the wet season is approaching.

OBJECT Navele	**Climate link** Timing of fruiting and flowering varies by latitude. Flowers and fruits either throughout the year or several times per year.
ACTION Flowers very late in the season	**Expected climate change response** Navele is likely to be intolerant to prolonged droughts and to increased saltwater contact. It has a medium to high tolerance to strong winds, including cyclones. Changes in the quality and quantity of fruit.
OUTCOME Wet season is approaching	

Wael Ken

Photo: Wikimedia Commons

OBJECT Wael Ken	**English name** Wild Cane
	Scientific name *Miscanthus sinesis or Miscanthus floridulus*
	Local name(s) Wael ken
	Description Wael Ken is reed or cane like. It is used as a traditional building material and, once the pith is removed, can be used to drink kava. It grows in clumps and is rhizomatous, meaning that it produces roots below the surface that send new plant shoots up to the surface.
ACTION Flowers at the end of winter	**Traditional knowledge** Flowering at the end of the winter period is a sign that the wet season is approaching.
	Climate link Flowering is linked to rainfall, degree days and mean temperature. Mild periods of water deficit may delay flowering. It flowers earlier in warmer years for some genotypes.
OUTCOME Wet season is approaching	**Expected climate change response** Does not tolerate a high salt content in the soil. Changes in the timing of flowering and growth patterns.

Beaches

OBJECT Beach	**English name** Beaches
	Local name(s) Ol sanbij
ACTION Direction of beach	**Traditional knowledge** The presence of a beach location in a different direction is a sign that the wet season is expected (Malekula). Which means if there are more sand alongside of the edge of the sea it means the wet season is approaching.
OUTCOME Wet season is approaching	**Climate link** When there is more sand alongside the edge of the sea it means that the wet season is beginning.

Air Temperature

OBJECT Air Temperature	**English name** Air temperature
	Local name(s) Aea tempretja
ACTION Noticeable increase in temperature/very hot days and nights (Santo)	**Traditional knowledge** 1. Heavy presence of an increase in temperature is a sign that the wet season is beginning 2. When days and nights are very hot it is a sign that the wet season is expected (Santo)
OUTCOME Wet season is beginning /approaching	**Climate link** During Wet season temperature is too high (Hot temperature), however in dry season temperature is too low and colder.

Clouds

OBJECT Clouds	**English name** Clouds
	Local name(s) Ol klaod
ACTION Dark cloud at east of island (Epi) /Lots of clouds in summertime /Cloudiness and thunderstorms (Epi)	**Traditional knowledge** 1. The presence of dark cloud at the east side of the island is a sign that the wet season is beginning (Epi) 2. Heavy presence of clouds during the summertime is a sign that the wet season is expected 3. Presence of cloudiness and thunderstorms is a sign that the wet season is beginning (Epi)

OUTCOME Wet season is beginning /approaching	**Climate link** — Big and dark clouds in the air show that the wet season or it will soon be rain that leads to cyclone season.

Earthquakes

OBJECT Earthquake	**English name** — Earthquakes **Local name(s)** — Ol ethkwek
ACTION Heavy earthquake	**Traditional knowledge** — The presence of strong earthquakes activity is a sign that the wet season is beginning (Epi)
OUTCOME Wet season is beginning	**Climate link** — The presence of heavy earthquake shows that the wet season is approaching.

Moon

OBJECT Moon	**English name** — Moon **Local name(s)** — Mun
ACTION New and Full moon (Epi) /Moon facing downwards	**Traditional knowledge** — 1. The presence of a new and full moon is a sign that the wet season is expected, and rain is expected (Epi) 2. The presence of the moon in a U direction is a sign that it is still the dry season but when the moon starts to tilt to face downwards, the wet season is expected 3. When the shape of the new moon is positioned as a letter 'C' in the sky, then it indicates that this month will be generally rainy (Pentecost)
OUTCOME Wet season is beginning	**Climate link** — When the moon is facing downward or full moon it is a sign that the wet season is approaching.

Rivers and streams

OBJECT Rivers and streams	**English name** — Rivers and streams **Local name(s)** — Ol riva mo krik
ACTION Water level increases	**Traditional knowledge** — When water levels increase it is a sign that the wet season is beginning
OUTCOME Wet season is beginning	**Climate link** — When the pressure of water in the river is increasing it show that the wet season will begin soon.

Sunrise

OBJECT Sunrise	**English name** — Sunrise **Local name(s)** — Taem san i kam ap
ACTION Reddish sky	**Traditional knowledge** — The presence of a reddish sky during sunrise is a sign that the wet season is expected to begin
OUTCOME Wet season is beginning	**Climate link** — The presence of strong reddish during sunset shows that the wet season is approaching.


The Dry Season

Key messages for Dry Season

- It runs from May to October
- It is the 6-month period where we usually receive less rainfall
- The driest months of the dry season are July, August, September
- During dry season, people are advised to manage water wisely

As described in the diagram above, the dry season occurs for about 6 months which is from May onward till October. However, the driest months during this period are July, August, and September. This means the sun is located over the northern hemisphere, which results in less heat and the temperature is starting to cool down in the southern hemisphere. This leads to strong hot in the day time, then cold in the night time, also people are advice to use water resource wisely.

Preparing for the Dry Season

Dry season is also one of the natural disasters that occur regularly of prolonged dry weather from the month of May to October as annual period of low rainfall in the tropics.

According to Vanuatu NDMO and VMGD, the preparedness of dry season is:

- Protect the trees, encourage people and make awareness about the importance of the trees during dry season
- Preserve water in a containers or tank that could be use during dry season
- Plant food and crops that could grow in a dry soil
- Prepare emergency kits
- Listening to the radio or department advice

Traditional Dry Season Knowledge

Chicken

Photo: JJ Harrison/Wikimedia Commons

OBJECT
Chicken

ACTION
On roof of house

OUTCOME
Dry season is approaching

English name	Red Jungle Fowl /Domestic Chicken
Scientific name	*Gallus gallus /Gallus domesticus*
Local name(s)	–
Description	Red Jungle Fowl were brought to Vanuatu as part of the early human migration across the Pacific. The fowl bred with subsequent introduced chicken species and dispersed. Chickens are a good source of meat, feathers for decorations, and bones for fertilizer.
Traditional knowledge	When chickens are found on the house roof it is an indicator of the dry season
Climate link	Low barometric pressure often precedes storms that result in rainfall. It is believed that birds can sense pressure changes through their paratympanic organ, located in the middle ear. Changes in atmospheric pressure have been associated with behavioural changes in birds, including increased activity.
Expected climate change response	As temperatures warm, shade and additional food sources are likely to be required for chickens. Drought-adapted crops and fodder plants can be used as alternative feed sources. Extreme temperatures are likely to result in heat stress.

Manguru

Photo: VMGD

OBJECT
Manguru

ACTION
Found at seashore

OUTCOME
Dry season has started

English name	Various – runners, jacks, mackerel scad
Scientific name	*Decapterus sp., Selar sp.*
Local name(s)	Manguru, Mangrou
Description	Manguru are predatory schooling fish that feed in inshore environments on fish, crustaceans and other invertebrates and offshore on zooplankton. Juveniles generally inhabit shallower reef and lagoon waters, moving to deeper water as they mature.
Traditional knowledge	1. The presence of manguru at the seashore indicates the dry season is has commenced (Tanna) 2. When Makuku, a fish that lives in the deep sea, comes near the seashore, people will say that the yam harvest will be perfect (size and quantity), that the sea will be hot and a longer dry season (Paama).
Climate link	Presence of manguru, pelagic species, near the coast is associated with warmer ocean temperatures and reduced salinity. The seasonal temperature cycle is reinforced by photoperiod.

Dolphin

Photo: Wikimedia Commons

OBJECT
Dolphin

ACTION
Swimming above the sea towards the west

English name	Dolphin
Scientific name	*Stenella sp.*
Local name(s)	Dolfin
Description	Dolphins like to stay in social groups. They have a robust body and short snout and large dorsal fin. Males are larger than females. They feed on many types of prey, including squid and small schooling fish. They use their teeth to grip their food before swallowing it whole, head first.
Traditional knowledge	Presence of dolphins swimming above the sea surface towards the west is a sign the dry season is approaching (Ureparapara)
Climate link	Dolphin movements closely linked to sea surface temperatures. Dolphins are known to follow seasonal migration of fish species, which in turn is linked to ocean conditions.

OUTCOME
Dry season is approaching

Expected climate change response	Ocean heat waves reduce survival and reproduction rates of both dolphin and their prey. Shifts in climate can lead to changes in the distribution of dolphins and their prey.

Nakavika

Photo: Forest and Kim Starr/Wikimedia Commons

OBJECT
Nakavika

ACTION
Flowers present

OUTCOME
Dry season is beginning

English name	Malay Apple
Scientific name	*Syzygium malaccense*
Local name(s)	Ghavika/kavika (Aniwa/Futuna), nakavika (Ambae), inyehegh (Aneityum), kvavika/nagveg/vigige (Banks), nakavika/nakafika/kafika (Efate), sefso/nika/purkaukau (Epi), weve (Erromango), ghabrha (Maewo), naravik/navi/ravigor (Malekula), ahi (Paama), ghavika/kavik maruh/kavik tememe (Pentecost), naghavira/vuhaviga/kevika/ne/vihaviha (Santo), kavika/nakavika (Shepherds), nangavi/nagnawi/nikaouk/ningarung/negavung (Tanna), neveviker/negebike (Torres)
Description	In Vanuatu, four to six different forms of this plant are recognised, based on the colour, size and taste of the fruits. The flowers and fruits can be either pink or white, depending on the form present. The wood from this tree can be used to make canoes.
Traditional knowledge	1. Flowering is a sign that the dry season is beginning. 2. Flowering indicates the dry season in 3 months' time
Climate link	Flowering is driven by climate and is commonly seen at the transition from the dry to wet season.
Expected climate change response	Extensive drought can cause significant leaf fall. Warming temperatures and rainfall changes can alter the timing and amount of fruiting and flowering.

Bluwota

Photo: Celine Ng/CC BY-NC-SA 2.0

OBJECT
Bluwota

ACTION
Leaves falling

OUTCOME
Dry season

English name	Rosewood
Scientific name	*Pterocarpus indicus*
Local name(s)	Bluwota, Naranara
Description	A large evergreen to deciduous tree that grows usually grows 15-20 metres tall, though individuals have grown up to 40 metres. The tree produces flower and fruit year-round in some locations and its colourful wood is highly valued.
Traditional knowledge	1. Loose leaves (leaves falling) is linked to the dry season (Epi). 2. When Bluewota tree and Natapua tree lose their old leaves, it is time to clear the bush for a new garden (Ureparapara)
Climate link	Bluwota is a deciduous tree but only when conditions become dry. Otherwise, it remains evergreen.
Expected climate change response	Potential climate change impacts on Bluwota are: a change in the habitat range, change in the timing of leaf fall and leaf budding, change in the timing, quality, and quantity of fruits and flowers.

Narara

Photo: Dinesh Valke/CC BY-SA 2.0

OBJECT
Narara

ACTION
Flowers present and tree loses its leaves

English name	Indian Coral Tree
Scientific name	*Erythrina variegata*
Local name(s)	Narara (Epi)
Description	This tree gets its name from the Greek for red (the colour of its flowers) and for variegated leaves. It is found throughout Vanuatu, usually around villages and gardens. It is a fast-growing deciduous tree, with all the leaves falling at once. New leaves appear after the flowering period. It is often used as a living fence post and to form tree lines along boundaries.
Traditional knowledge	1. When Narara flowers and loses leaves it is an indication that the dry season has started, and it is time to plant yams (Epi). 2. When Narara leaves start falling off, it indicates a cold season (Pentecost) 3. In central Pentecost, the onset of flowering towards the end of the dry season is used as an indication that it is time to start clearing gardens for the following planting season (Wheatley, 1992, Trees of Vanuatu).

OUTCOME Dry season has started	**Climate link** — Low temperatures and or drought, combined with windy conditions, accelerate leaf drop. Flowering occurs when the tree is leafless in summer (end of dry season) and fruiting follows soon after (end of dry season /rainy season). Flowering and fruiting in the tropics are influenced mainly by soil moisture and rainfall patterns. **Expected climate change response** — Potential climate change impacts include a change in the timing of leaf fall and leaf budding, change in the timing, quality, and quantity of flowers and seeds.

Ground

OBJECT Ground	**English name** — Ground **Local name(s)** — Graon
ACTION Dust	**Traditional knowledge** — The presence of dust is a sign that the dry season is beginning (Epi)
OUTCOME Dry season is beginning	**Climate link** — When there was too much dust in the ground it means the dry season is approaching

Air Temperature

OBJECT Air temperature	**English name** — Air temperature **Local name(s)** — Aea tempretja
ACTION Low temperatures	**Traditional knowledge** — 1. When daytime and night-time temperatures are very low then hot it is a sign that the dry season is expected (Epi) 2. When there is a presence of low in temperature then is a sign that the dry season is expected
OUTCOME Dry season is beginning	**Climate link** — There is a difference in the air temperature which means when there is a low temperature during daytime or nighttime then it means we will be expecting dry season.

Clouds

OBJECT Clouds	**English name** — Clouds **Local name(s)** — Ol klaod
ACTION Many during daytime	**Traditional knowledge** — Heavy presence of clouds during daytime is a sign that the dry season is expected
OUTCOME Dry season is approaching	**Climate link** — Heavy presence of clouds during the day time shows a sign that the dry season is approaching.

Sun

OBJECT Sun	**English name** — Sun **Local name(s)** — San
ACTION Circle around the sun	**Traditional knowledge** — The presence of a circle around the sun is a sign that the dry season is expected (Epi)
OUTCOME Dry season is approaching	**Climate link** — When there is a presence of a circle around the sun it means we are approaching dry season in a few months

Earthquakes

OBJECT Earthquake	**English name** — Earthquakes **Local name(s)** — Ol ethkwek
ACTION Small earthquake	**Traditional knowledge** — The presence of light earthquake is a sign that the dry season is beginning (Epi)
OUTCOME Dry season is beginning	**Climate link** — When there was a light earthquake it means the dry season will occur few months later.

Moon

OBJECT
Moon

ACTION
Circle around the moon /moon in U or V shape

OUTCOME
Dry season is approaching /beginning or ongoing

English name	Moon
Local name(s)	Mun
Traditional knowledge	1. The presence of a circle around the moon is a sign that the dry season is expected (Epi) 2. The presence of the moon in a U or V shape is a sign that the dry season is beginning 3. The presence of the moon in a U direction is a sign that it is still the dry season (many, including Pentecost)
Climate link	When there was circle around the moon, or the presence of moon in a shape of letter U or V is the sign of dry season approaching.

Rivers and streams

OBJECT
River and streams

ACTION
Water level drops

OUTCOME
Dry season is beginning

English name	Rivers and streams
Local name(s)	Ol riva
Traditional knowledge	When stream and river levels drop it is a sign that the dry season is beginning
Climate link	When the level of stream and rivers were drop it is the sign that there be dry season soon.

Ocean

OBJECT
Ocean

ACTION
Waves very loud

OUTCOME
Dry season is approaching

English name	Ocean
Local name(s)	Solwota, Osen
Traditional knowledge	When waves wash ashore with a very loud sound it is a sign that the dry season is expected (Epi)
Climate link	At the ocean when there is a change in the level of the waves which means when the wave washes ashore with a very loud sound, it's a sign that dry season is approaching.

Night sky

OBJECT
Sky

ACTION
Stars in distant locations /lots of stars

OUTCOME
Dry season is approaching

English name	Sky
Local name(s)	Skae
Traditional knowledge	1. Starry skies in distant locations is a sign that the dry season is expected (Epi) 2. Heavy presence of starry skies is a sign that the dry season is expected (Epi)
Climate link	During the night time when the stars are in distant location, or if there are many stars in the sky it means dry season is approaching.

Sunset

OBJECT
Sunset

ACTION
Sky and sun yellow /very red colour

OUTCOME
Dry season is approaching

English name	Sunset
Local name(s)	Taem san i ko daon
Traditional knowledge	1. Sunset with the sky and sun turning yellow is a sign that the dry season is expected 2. The presence of very strong reddish colour during sunset is a sign that the dry season is beginning 3. Heavy presence of strong reddish colour during sunset is a sign that the dry season is beginning
Climate link	Sunset with strong yellow or reddish colour the sign that the dry season will soon begin.

El Niño and La Niña and other climate and weather traditional knowledge

El Niño and La Niña

What is El Niño Southern Oscillation?

El Niño Southern Oscillation (ENSO) is a big process that takes place in our vast Pacific Ocean. This big process mainly involves movement of huge bodies of warm water from the east to the west of the Pacific, generating El Niño and La Niña.
El Niño Southern Oscillation (ENSO) has three stages. These are *Neutral*, *El Niño*, and *La Niña*.

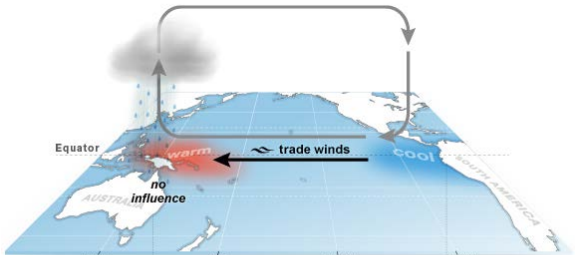


Fig. 1 Neutral Condition
Across the Pacific Ocean, trade winds blow from east to west, piling up warm waters to the north of Australia. This area of warm water is called the 'warm pool', and it covers most of the Melanesian countries including Vanuatu. Over the warm pool, we normally experience frequent cloudy and rainy conditions. That is why in Vanuatu, we typically experience frequent rainfall throughout the year. This is the neutral or 'normal condition'.

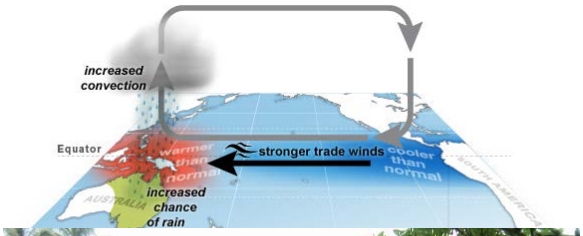
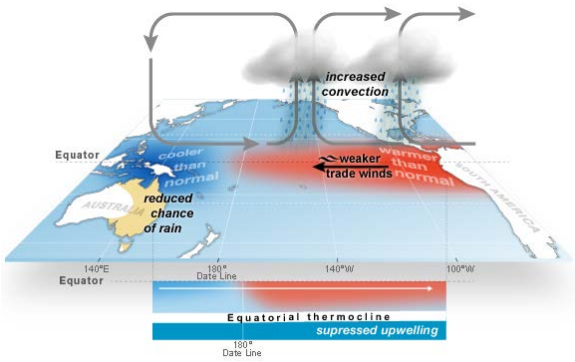


Fig. 2. (a) La Niña
During a La Niña stage, trade winds become stronger causing the effect of the warm pool to become stronger. The temperature of the warm pool becomes warmer than normal, causing more cloudiness and frequent heavy rainfall over the Melanesian countries including Vanuatu.

Fig. 2(b) Heavy rainfall during a La Niña
A La Niña usually develops around March–August and decays during the months of March to May. It can last up to 2-3 years, and occurs every 3–7 years. During La Niña, we usually experience extreme wetter conditions that can result in serious flooding and landslide events.



El Niño–Southern Oscillation (ENSO): **El Niño**

Fig.3(a) El Niño
During an El Niño stage, trade winds become weaker causing the effect of the warm pool to weaken. The temperature of the warm pool becomes cooler, causing less cloud and below normal rainfall over the Melanesian countries including Vanuatu.

Fig. 3(b) Drier conditions during an El Niño
An El Niño usually develops around March–August and decays during the months of December–February. It can last for 6 months up to 2 years, and occurs every 3–5 years. During an El Niño, we usually experience extreme drier conditions that can result in water shortages and crop mortality across the country.

Other Traditional Knowledge

Chicken

Photo: JJ Harrison/Wikimedia Commons

English name	Red Jungle Fowl /Domestic Chicken
Scientific name	*Gallus gallus /Gallus domesticus*
Local name(s)	Faol
Description	Red Jungle Fowl were brought to Vanuatu as part of the early human migration across the Pacific. The fowl bred with subsequent introduced chicken species and dispersed. Chickens are a good source of meat, feathers for decorations, and bones for fertilizer.
Traditional knowledge	When chickens appear agitated it is a sign of that a rainfall is approaching the next day or the following week (Epi)
Climate link	Low barometric pressure often precedes storms that result in rainfall. It is believed that birds can sense pressure changes through their paratympanic organ, located in the middle ear. Changes in atmospheric pressure have been associated with behavioural changes in birds, including increased activity.

Moon

Photo: NASA

English name	Moon
Local name(s)	Mun
Traditional knowledge	1. The moon upside-down is a sign that the rain is expected (Santo) 2. The presence of a new moon in a north-west direction facing Santo is a sign that rain is expected
Climate link	The presence of the moon upside down or new moon in northern west direction facing the island are the sign that there will be a rain in a few days or month.

Further Information

The papers below provide additional information on protocols and procedures associated with the Van-KIRAP (and COSPPac) projects, including the collection and storage of traditional weather and climate knowledge. They are available for free download using the links provided.

Malsale P, Sanau N, Tofaeono TI, Kavisi Z, Willy A, Mitiepo R, Lui S, Chambers LE, Plotz RD (2018) Protocols and partnerships for engaging Pacific Island communities in the collection and use of traditional climate knowledge. BAMS 99: 2471-2489
https://journals.ametsoc.org/view/journals/bams/99/12/bams-d-17-0163.1.xml?tab_body=pdf

Chambers LE, Plotz RD, Dossis T, Hiriasia DH, Malsale P, Martin DJ, Mitiepo R, Tahera K, Tofaeono TI (2017) A database for traditional knowledge of weather and climate in the Pacific. Meteorological Applications 24: 491-502
https://rmets.onlinelibrary.wiley.com/doi/full/10.1002/met.1648