

TRAVEL REPORT FORM

출장보고서

결 재	선임연구 원	팀장	부서장	부서장
	12/03 김광형	12/04 문자연	대결 12/06 윤여훈	대결 12/06 윤여훈
협 조				

I. Travel Overview 출장개요

1. Traveler(s) 출장자

Department 소속	Position 직위(직급)	Name 성명	Note 비고
예측기술팀	선임연구원	김광형	

2. Travel Period 출장기간

– 2018년9월9일-15일

3. Occasion and destination 행사 및 출장지

- 행사: Climate Change Conference-2018 (9/11-13)
- 출장지: 파푸아뉴기니 고로카 (Goroka, PNG)

“주: 본 출장보고서는 출장자의 실수로 출장 이후 바로 제출하지 못하고 12월3일에 제출하게 됨”

II. Major Activities 주요업무 수행내용

1. Main Contents and Activities 주요내용 및 활동

- PNG에서 개최되는 Climate Change Conference-2018 (9/11-13) 참석 및 발표 (Keynote Speaker) “Theme: Climate Change: our environment, livelihoods, and sustainability”
- APCC 소개 및 APCC의 기후정보 활용을 통한 아태 지역 기후변화 및 변동 적응 노력에 대해 소개 “발표제목: Lessons Learned for the Establishment of Climate Service for Agriculture in the Pacific Island Countries” (첨부된 발표자료 참조)

2. Relevance to APEC Climate Center’s Activities 결론 및 소감

- Climate Change Conference-2018는 PNG에서 열리는 APEC회의의 연계행사 중 하나로서, 바로 이전에 개최된 2018 APEC Climate Symposium의 주제와 자연스럽게 연결되며, 지역을 대상으로한 기후정보의 활용과 그것을 실제로 실현하기 위한 다양한 방법론에 대한 논의가 이루어졌음
- 특히 PNG 환경부 장관과 주요 국장급이 참석하여 APEC Climate Symposium에서 발췌된 policy recommendation에 대해서 소개하고 해당 컨퍼런스가 그와 연계된

-
- 실제적인 regional local policy를 수립하는데 도움이 되는 장이 될 것을 주문함
- APCC에서는 해당 컨퍼런스에 참석하여 아태 지역의 대표적인 Regional Climate Service Provider로써 APCC 기후정보서비스 프로젝트의 성과를 소개하였고, 이러한 노력들은 타지역의 결과물들을 아태 지역에 파급시키는 장기적인 효과가 있을 것으로 판단함
 - 참석한 연구기관 및 대학, 지역 NGO, 정부관계자들은 APCC의 상세화된 기후정보 활용에 대한 높은 관심이 있었으며, PNG와 같은 새로운 지역 대상 프로젝트에 해당 상세화 기술이 적용된 기후정보를 활용하는 것이 가능한지에 대한 활발한 토의를 진행
 - 그간 아태 지역을 대상으로 한 APCC의 활동 및 경험 사례를 통해 2018 APEC 우선순위 의제인 “Building capacity of local institutions to address the various forms of climate change induced impact“에 기여하고 향후 PNG 및 아태지역 국가들의 기후변화 대응 정책의 공통된 합의점 도출
 - 또한 해당 컨퍼런스에 참석한 다국적 연구기관들과의 네트워크 구축을 통해 APCC에서 현재와 미래 수행할 태도국 대상 프로젝트에서 활용할 수 있는 전문가 풀 및 공동연구기회의 창출이 가능하게 되었고, 관련해서 실제적인 action plan (농업전문가 활용 및 PNG 대상 사업에 APCC의 참여 기회 논의 등)을 협의함

3. Suggestions and Remarks 건의사항

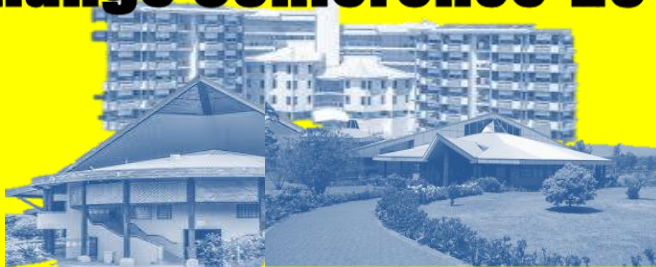
III. References (Presented and Collected Materials) 주요 수집자료

(with attachment of any information or report in case of attendance of conferences, workshops and meetings) 학술대회, 워크숍, 회의 등 참석 시 관련 정보 및 문서 첨부

Climate Change Conference-2018



September 11-13



UNIVERSITY OF GOROKA
PAPUA NEW GUINEA

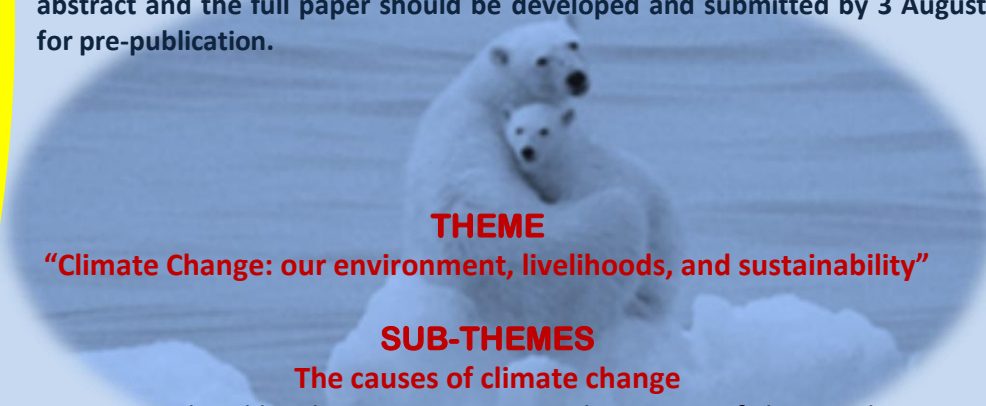


CALL FOR ABSTRACTS

The School of Science and Technology of the University of Goroka is hosting a climate change conference scheduled from 11th to 13th September 2018, and is seeking expressions of interest in participation.

Abstracts of proposed papers addressing one or more of the following themes should be sent to the organizers by 15 June. Abstracts should be no more than 300 words and clearly set out the content and conclusions of the proposed paper.

Acceptance or otherwise of the paper will be notified by 29 June for the abstract and the full paper should be developed and submitted by 3 August for pre-publication.



THEME

“Climate Change: our environment, livelihoods, and sustainability”

SUB-THEMES

The causes of climate change

- International and local investigations into the causes of climate change
- Understanding global warming
- Scientific, technical, and socioeconomic aspects of climate change

The impact of Climate Change on the environment and on livelihoods

- Methods of assessment to detect changes
- Observed global and local changes and impacts
- Immediate and long term effects of global warming

Current and emerging adaptation and mitigation options

- Sustainable development mechanisms
- Climate-resilient development pathways
- Carbon neutral pathways
- Traditional knowledge of adaptation and coping strategies

Account details

Account Name: The University of
Goroka – Special Purpose Account
Account Number: 2605608601
Bank: Westpac Bank - Goroka
Code- 9-3075

For more information visit: University of Goroka website, www.unigoroka.ac.pg

EMAIL ABSTRACTS TO

Dr Mathew Landu, Tel: (675) 531 1805, e-mail: landum@unigoroka.ac.pg ,
Prof. Alan R. Quartermain, Tel: (675) 531 1769, e-mail: quartermaina@unigoroka.ac.pg
and copy your abstracts to climatecoolgoroka@gmail.com

Climate Change Conference-2018

September 11-13

University of Goroka

Papua New Guinea

Lessons Learned for the Establishment of **Climate Services** for Agriculture in the Pacific Island Countries

Kwang-Hyung Kim, CLIMATE SERVICES AND RESEARCH DAPARTMENT @APEC CLIMATE CENTER





Climate Change in the Pacific

(ADB, 2013)

HEALTH: FORGONE INCOME AND ILLNESS TREATMENT

Most health costs arise from...



RESPIRATORY
DISORDERS



MALARIA



DEATH AND INJURY
FROM TROPICAL STORMS

PROJECTED SHARE OF TOTAL MORTALITY COST BY 2100

80%

14%

● respiratory diseases
due to climate change

● vector-borne diseases
(particularly malaria)

CORAL REEFS: DECLINE IN COVER

1995 88%

2050 55%

2100 20%



AGRICULTURE: CROP YIELD LOSS



OVER 50% YIELD LOSS
for sweet potato crops in PNG by 2050



7% - 21% YIELD LOSS
for sugarcane in Fiji by 2070

FISHERIES: CATCHES REDUCED



OVER 20% DECLINE
in skipjack tuna catches in the Western Pacific
under a high emissions scenario



7.5% DECLINE
in total catch across the region
under a medium emissions scenario

When we recognized a PROBLEM ...

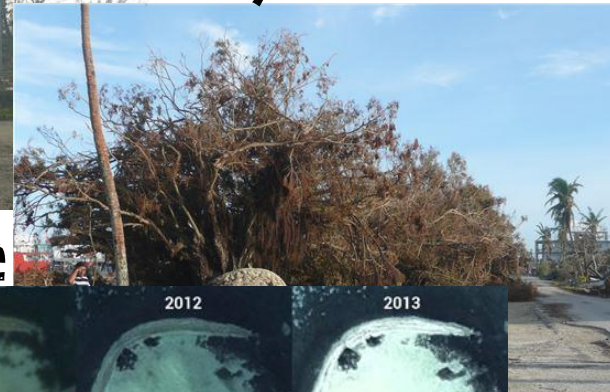
Climate Change
& Variability
and Extremes
Get Worse!



drought



cyclone



sea level rise



A holistic approach is needed to solve the **PROBLEM~!**

Climate Change
& Variability
and Extremes
Get Worse!



Mitigate...

and Adapt...



and Fight ~!



A holistic approach is needed to solve the **PROBLEM~!**

Tonga AgroMet Project - A Model Project for the Establishment of Climate Services in the Pacific to Enhance Food Security in a Sustainable Manner

Climate Information Services

- Tonga Meteorological Service: historical weather data, nowcast, warnings, weather/climate forecasts
- Installation of agro-met station
- Delivery: radio, TV, email, apps
- National Climate Outlook Forum

Climate Smart Technologies

- Agromet index-based crop phenology and yield prediction
- ICT technologies for data collection & analysis, and information delivery
- Crop model-based decision support tool
- Crop disease & pest spray tool

Tonga Agricultural Community

Agricultural Development Plan

- Tonga Agriculture Sector Plan (2016-20)
- Cooperation with local NGOs for community level adaptation strategy
- National Agriculture Data Management Plan by the MAFFF

Local Knowledge and Institutions

- Establish AgroMet Working Group
- Capacity building for extension, NGOs, commercial farmers
- Farmer field school or national forum
- Traditional knowledge and know-how sharing



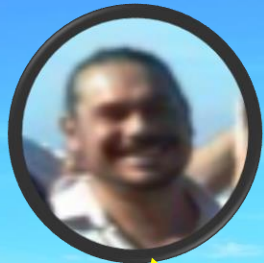
PROJECT OVERVIEW

- Country Partners : **TONGA MAFFF & TMS**
- Period : **2014 ~ 2016**
- History :

Fiji

Tuvalu

Wallis and



So... It goes back to 2014!
At the Regional Consultation
on Climate Services for Pacific
Small Island States (Apr. 2014)



PROJECT OVERVIEW

During a coffee break...

We need our own agro-met services to help our farmers in Tonga. For this, we gotta first rescue our agriculture hardcopy data from missing and damaging.

(Wow... These guys will surely be my BIGGEST supporter!)
Why don't we start an agromet project for Tonga farmers. Great, let's do it !

**Hey~!!
The climate service is my oyster~!!
You can't do that without me~!**

We can use our weather & climate data to make useful information for our agriculture stakeholders.

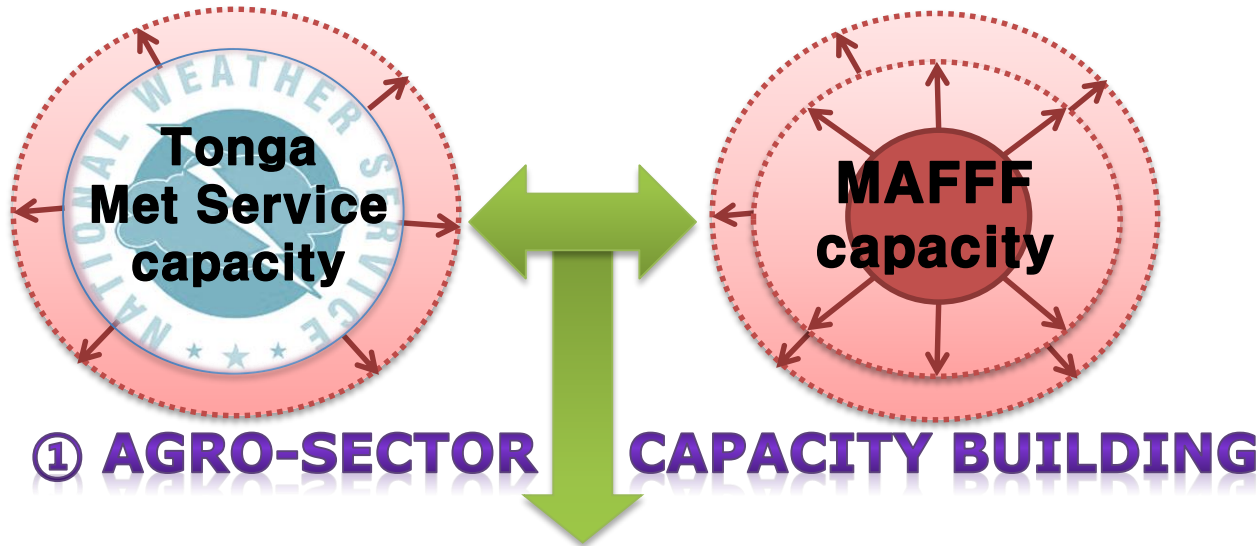
Agriculture

Climate



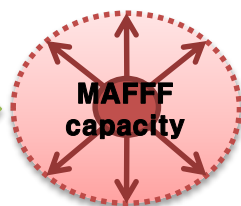
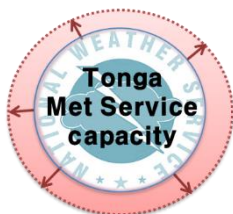
Tonga AgroMet Project

- Enhancing Climate Service through Ensuring Data Availability



Tonga AgroMet Project

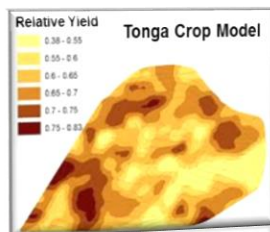
- Enhancing Climate Service through Ensuring Data Availability



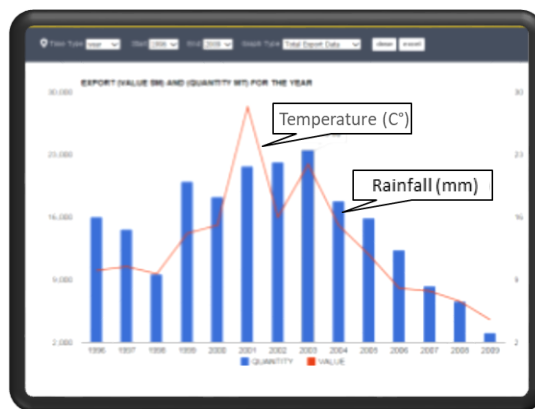
① AGRO-SECTOR CAPACITY BUILDING



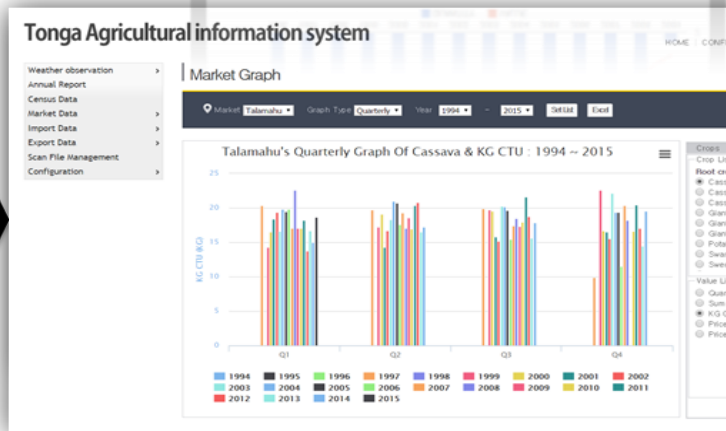
② CLIMATE SERVICES FOR AGRICULTURE



1. Development of an agriculture database
2. Generation of agro-met information



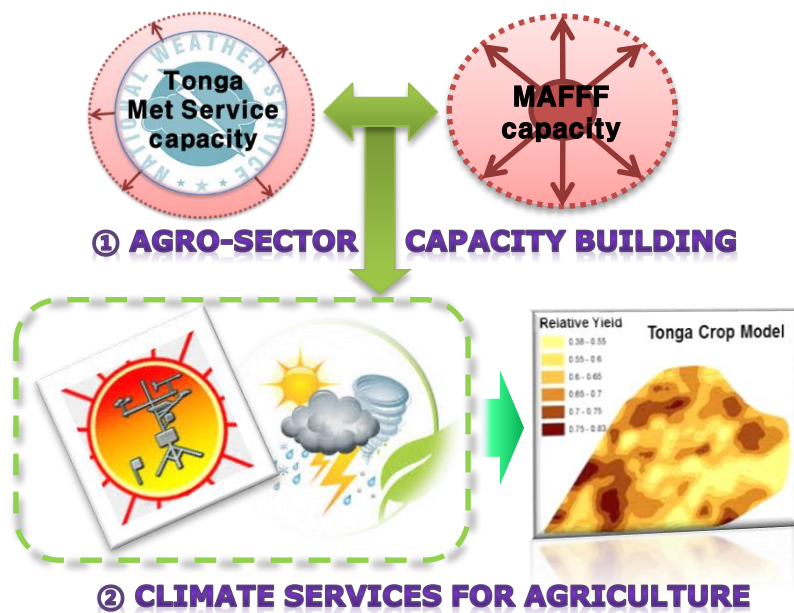
AgroMet Station



DB management system (TAIS)

Tonga AgroMet Project

- Enhancing Climate Service through Ensuring Data Availability



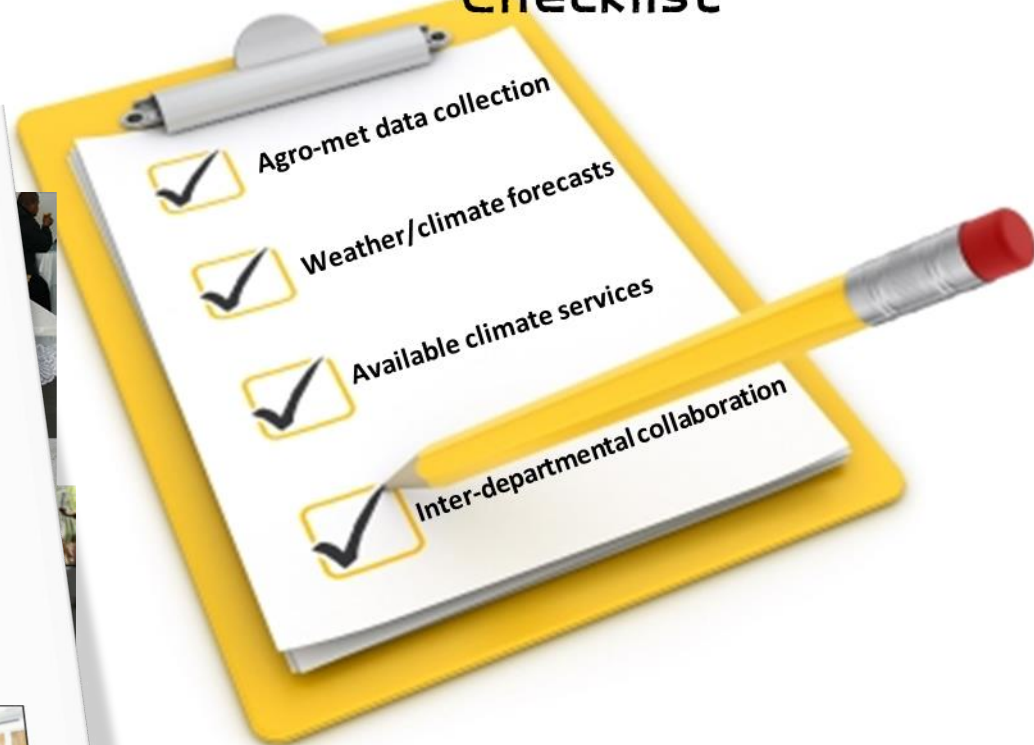
1. Development of an agriculture database
2. **Generation of agro-met information**
3. Development and delivery of agro-climate services
4. **Assessment of users' needs and capacities**
5. Research on the core relationships between climate and agriculture through modeling and field trials



Challenge 1. Climate service should be based on stakeholder-driven portfolios

1. Initial assessment of the current level of climate service for agriculture in the target country

Climate Service for Agriculture Checklist





Stakeholder-driven portfolios = Options for farmers, extension and local partners

1. Initial assessment of the current level of climate service for agriculture in the target country

2. Identification of the long list of climate service needs based on the initial assessment and multiple stakeholder workshops

Recommendations and Way Forward

- Farmers well prepared for next El Nino events
- Improved capacity for data management
- Easy access to weather/climate information, be clear about limitations of forecast, education, increased forecast accuracy
- Effective control on unexpected crop disease and pest outbreak due to climate variabilities
- Improved partnerships and communications of climate information
- Increasing incomes : improved quality and quantity of crop products for export and local market and improved risk management capacity to variable climates
- Increased understanding on climate and biological interactions
- Sustaining project outcomes and building capacity



Stakeholder-driven portfolios = Options for farmers, extension and local partners

1. Initial assessment of the current level of climate service for agriculture in the target country
2. Identification of the long list of climate service needs based on the initial assessment and multiple stakeholder workshops
3. Narrowing down the options by cost/benefit analyses and urgency-based selection
4. Development of **final climate service portfolios** with best outcomes from focus group meetings



Selection of realistic, practical service options through further intensive discussions

- Discussion with partners for operational capacity

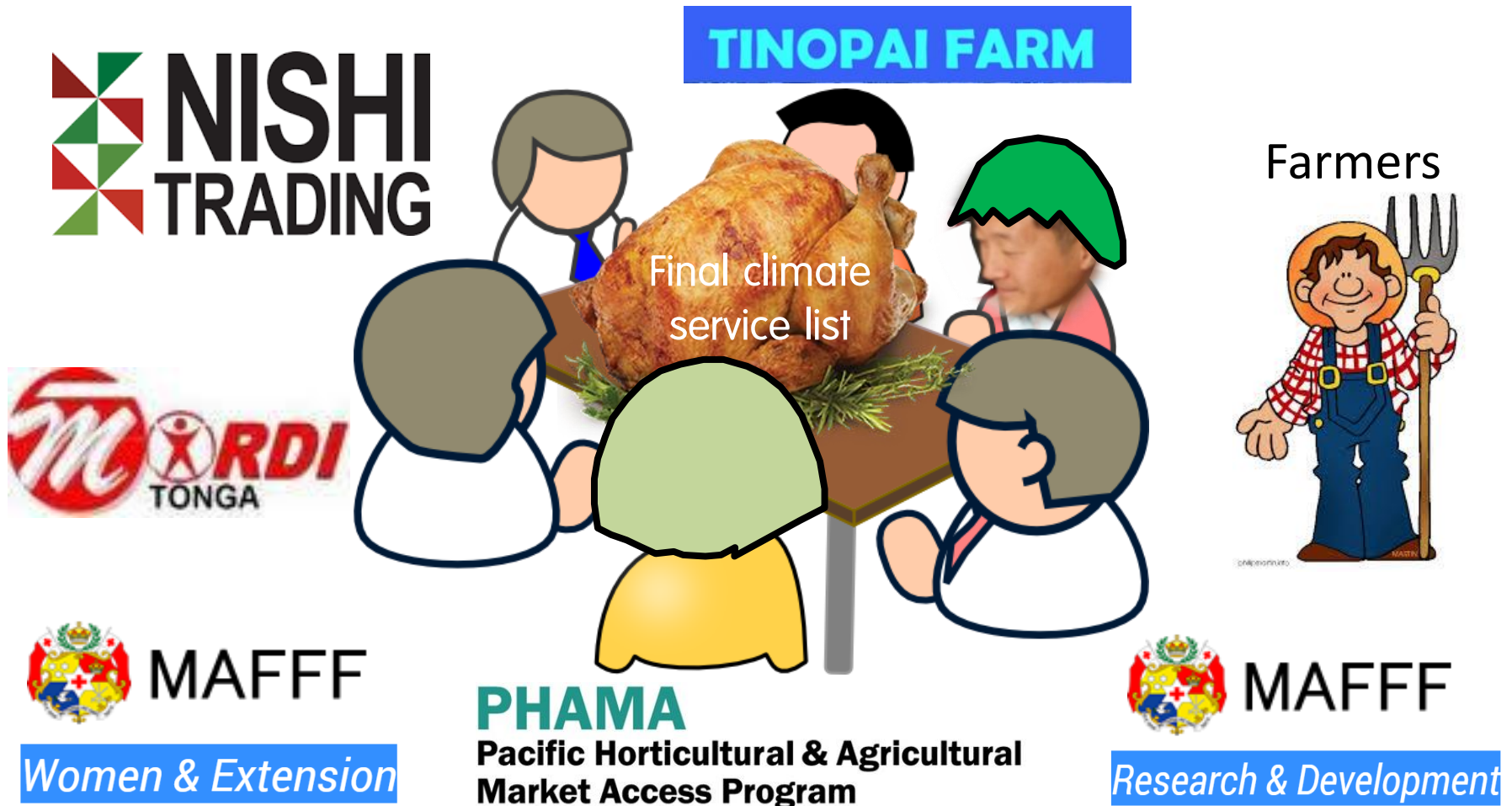


- AgroMet Working Group Meetings



Selection of realistic, practical service options through further intensive discussions

- Communications with Stakeholders (public and private)

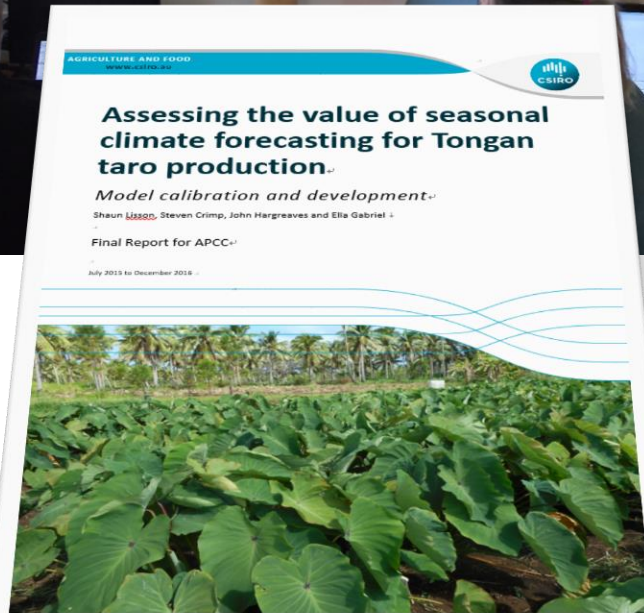
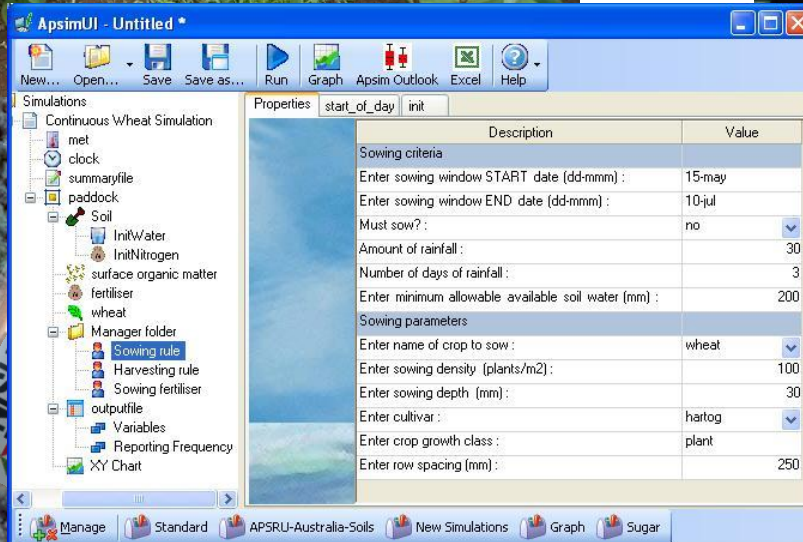
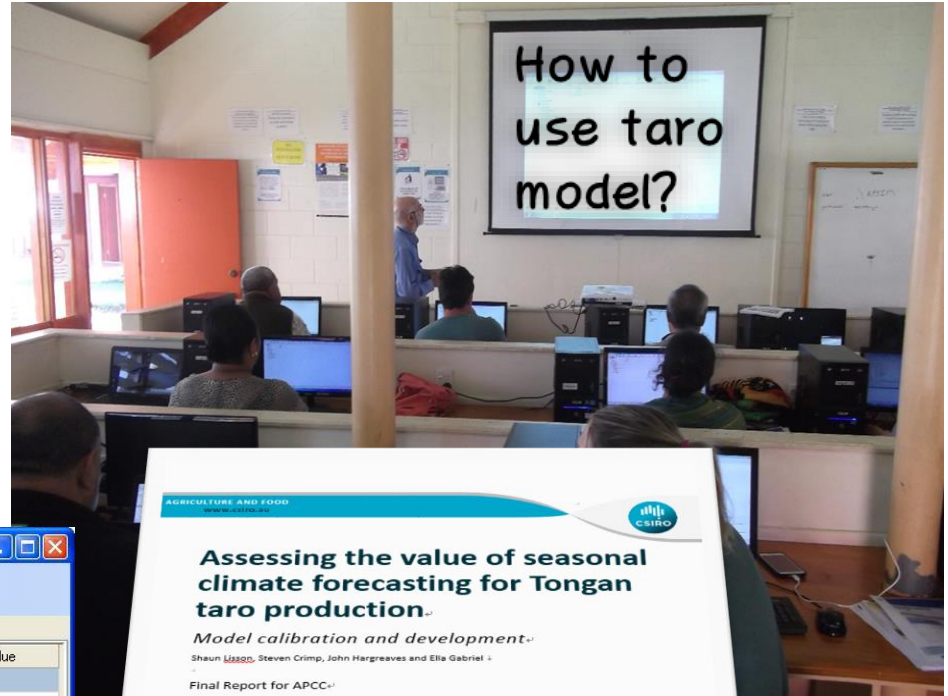


Challenge 2. Decision making should be supported by sound, state-of-the-art science and technology

- Taro simulation model development for farm decision making support

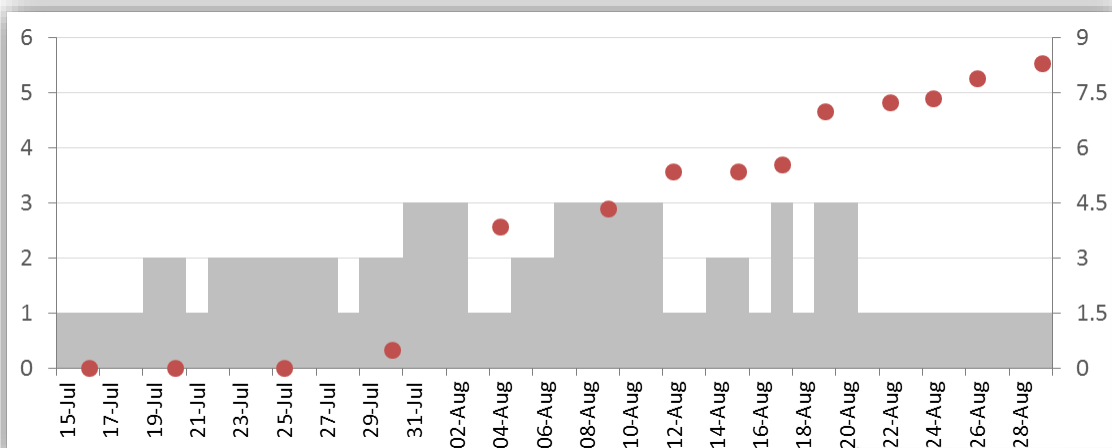


MAFFF



Research on the core relationship between climate and agriculture

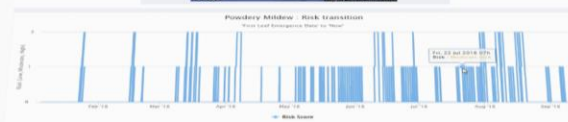
● Disease spray model development and field validation for disease control



Treatment	Farmer's	ToCSA-based
Number of spray	5	3
Final Yield (mt/ha)	5.8	6.1
Max Disease Severity (%)	6.5	7.4

Spray protocol with ToCSA

- During two weeks from planting, you don't need to pay attention to the risk score, because there have been very few powdery mildew incidence reported during the period
- After two weeks from planting, you may want to check the risk score every five days
- If you find high risk peak over the last days, you will need to take a close look at the field to find any symptoms of powdery mildew. If you find symptom, spray systemic fungicide right away
- Or, you may just spray a systemic fungicide at least within 3 days after the high risk score. However, if another high peak appears within 7 days after the systemic fungicide application, don't need to spray another
- During moderate risk period, watch over the field for any powdery mildew epidemic



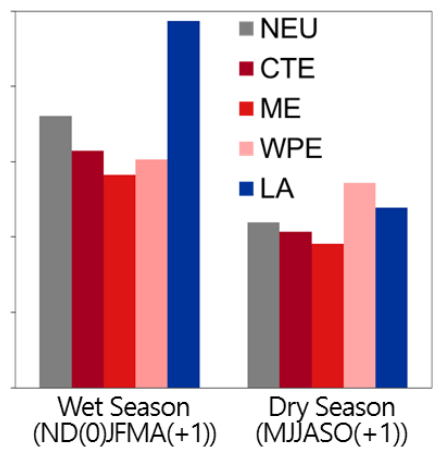


Research on the core relationship between climate and agriculture

Statistical model development for yield prediction with ENSO forecasts



Climate

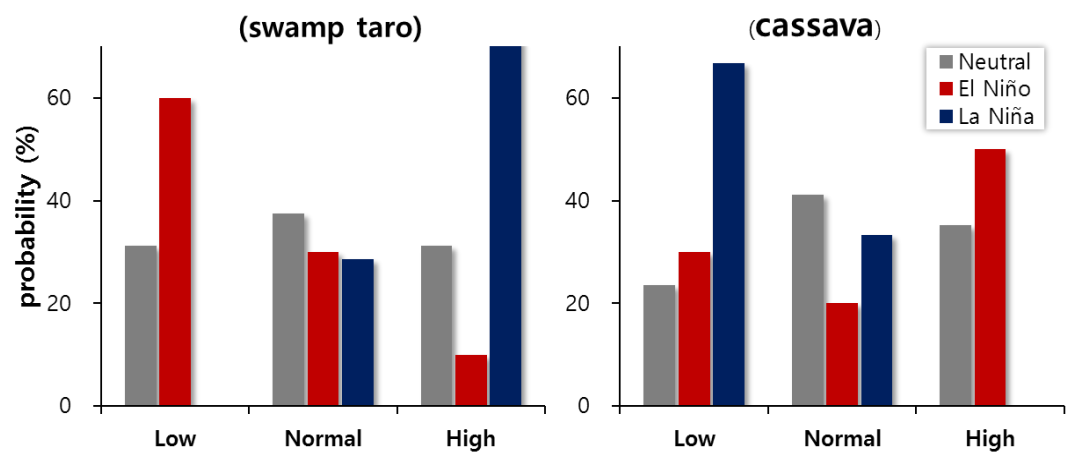


+

Agriculture

crop	CTE		WPE		ME		All El Nino		NEU		LA		P-value	
	mean	st.dev.	mean	st.dev.	mean	st.dev.	mean	st.dev.	mean	st.dev.	mean	st.dev.	five ENSO phases	three ENSO phases
Tomato	118.92	18.70	74.96	72.65	124.70	70.48	108.62	62.97	135.99	86.40	101.77	141.93	0.943	0.546
Beans	14.73	7.92	7.20	5.27	9.17	2.99	9.69	5.00	12.61	6.76	4.13	1.14	0.032	0.013
Capsicum	20.43	3.13	13.38	7.31	17.15	5.07	16.67	5.59	18.25	9.10	12.97	5.14	0.549	0.356
Carrot	29.17	5.03	23.43	15.72	24.19	7.10	24.96	9.23	21.97	10.26	16.71	8.64	0.562	0.273
Onion A	5.53	1.05	2.29	0.82	4.62	3.13	4.10	2.51	6.85	5.44	6.31	10.01	0.778	0.500
Onion B	2.12	0.81	0.83	0.35	5.22	8.72	3.28	6.19	2.13	1.47	1.42	1.99	0.397	0.581
Lettuce	17.81	1.98	10.32	4.93	10.14	6.11	11.73	5.72	13.03	6.97	6.48	4.91	0.156	0.107
Head cabbage	33.70	17.88	52.74	41.49	34.71	12.10	39.91	23.70	48.23	20.81	24.30	15.13	0.148	0.068
Chinese cabbage	29.59	5.23	19.97	17.90	25.39	7.42	24.60	10.57	37.09	20.97	13.76	5.68	0.170	0.114
Cucumber	17.93	13.46	24.70	13.95	20.94	11.37	21.47	11.28	20.35	11.99	19.83	11.68	0.974	0.957
pumpkin	7.54	0.02	0.97	1.67	6.52	5.89	5.06	4.92	5.16	5.19	1.95	3.68	0.283	0.369
Zucchini	4.70	0.76	0.58	0.95	2.86	2.91	2.54	2.53	3.95	3.54	0.81	0.77	0.126	0.087
Lu	60.64	12.61	25.73	24.83	36.51	16.05	38.10	20.85	40.87	23.06	19.21	12.70	0.099	0.077
Pele	26.17	15.02	14.34	15.05	19.98	6.16	19.53	10.54	18.91	10.46	13.69	9.45	0.576	0.507
Swamp taro	44.45	27.21	56.16	13.66	73.19	57.15	62.33	41.53	54.10	27.29	118.67	60.77	0.028	0.006
Taro tarua	290.58	3.97	159.92	96.28	238.70	166.75	225.44	129.96	272.59	173.14	370.89	414.45	0.746	0.457
Giant taro	51.19	21.28	47.31	42.99	88.82	100.02	68.84	73.16	122.34	172.83	51.93	73.20	0.778	0.446
Sweet potato	981.88	474.41	198.55	186.23	416.85	286.63	464.37	391.85	404.45	304.79	403.31	716.29	0.343	0.933
Cassava	927.02	240.25	336.17	336.86	523.04	223.33	547.78	317.84	551.36	239.83	269.88	119.58	0.013	0.063
Yam	240.28	77.68	168.11	144.02	174.83	92.28	185.91	99.47	207.00	121.61	130.24	93.30	0.631	0.358
Potato	11.17	15.79	7.98	5.90	8.31	6.34	8.78	7.41	12.11	10.39	5.14	2.16	0.553	0.230
Banana	193.23	241.65	43.98	51.40	213.56	261.67	158.62	209.36	188.31	223.78	87.76	164.08	0.694	0.608
Plantain	61.73	44.39	96.76	136.91	89.20	78.15	85.97	85.29	95.80	73.75	64.78	115.62	0.942	0.748
Pata	19.45	4.04	27.06	36.47	15.26	13.10	19.64	20.07	133.39	457.51	9.99	5.84	0.914	0.606

== Statistical models on crop supply and climate





Research on the core relationship between climate and agriculture

● Seasonal market price estimation based on seasonal climate forecast

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Weather Service

AgroMet Service

Farm Diary

Communications

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Seasonal Market Price Estimation

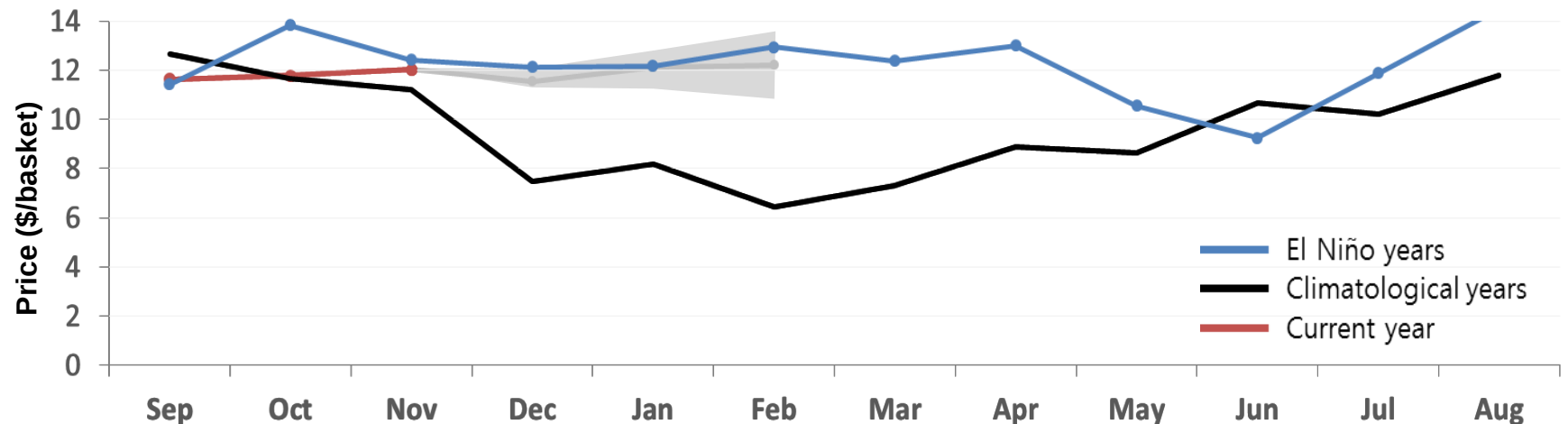
Station

Tongatapu and 'Eua

Crop

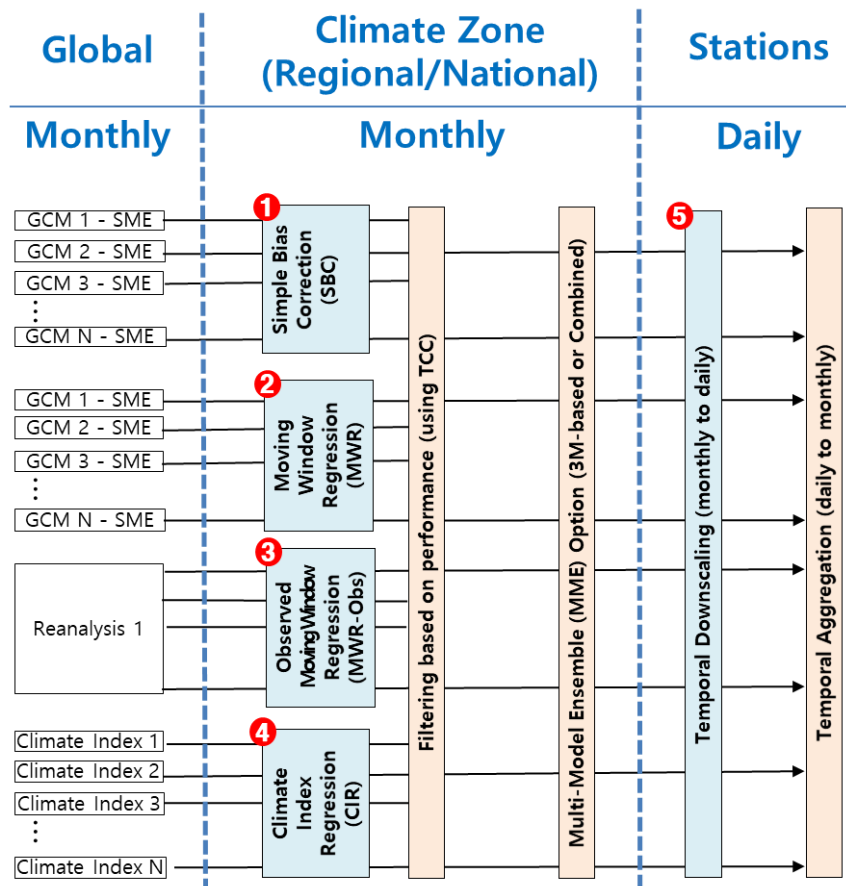
Talotonga/Taro

Swamp Taro Market Price (\$/basket)

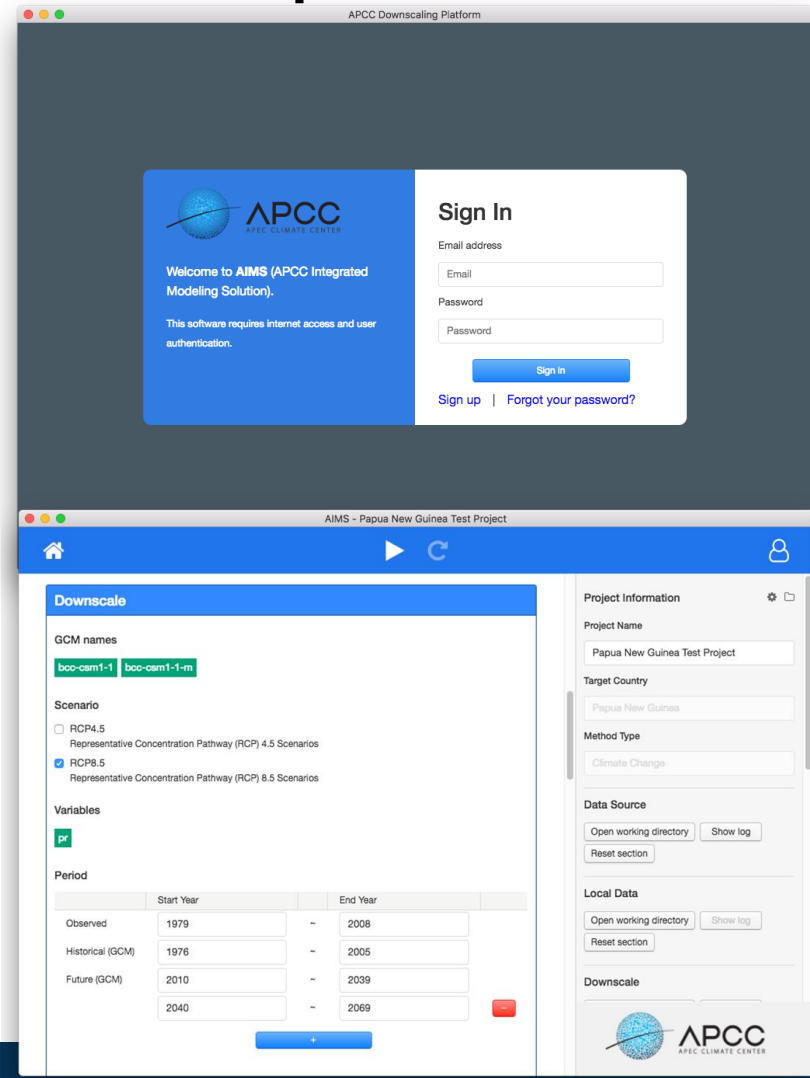


Research on the core relationship between climate and agriculture

- **Downscaling of seasonal forecast for local specific decision making**



(Cho et al, 2017)





Putting all the results from the R&D activities into Agro-Climate Service Box

Traditional Knowledge

Disease spray models

Taro simulation model

Statistical model
for yield prediction
with ENSO forecasts

Weather and Climate Information



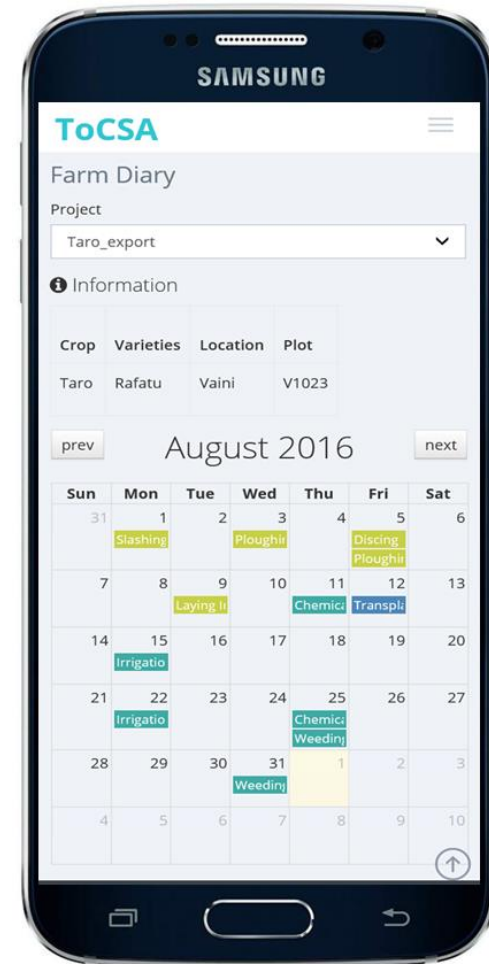
Development and delivery of the ICT-based agro-climate services in Tonga

Tonga Climate Service for Agriculture (ToCSA)

The screenshot shows the ToCSA web interface. At the top, there is a 'Login' button and the 'ToCSA' logo. Below the logo, there is a navigation bar with 'Home', 'Weather Service', and 'AgroMet Service'. The main content area is titled 'Climate Smart Farming' and includes a 'Home' link, 'AgroMet Service', and 'Climate Smart Farming'. A 'Question' section asks: 'Which island group are you cropping in?', 'What crop are you growing?', and 'Which cropping phase of your crop?'. Below this, a 'Seasonal Rainfall Forecast for the next 3 months' section shows 'Dec to Feb : Normal (56 %)' with a downward arrow. The 'Crop' section shows 'Talotonga/Taro' with a downward arrow. The 'Cropping Phase' section shows 'Land Preparation' with a downward arrow. The 'Activity' section shows 'Planting Material'. At the bottom, a 'Recommendations' section provides advice on selecting suckers and stalks for export or local market.

- Weather/Climate Information
 - Observations and Forecasts
 - Tongan / English
- AgroMet Index-based Warning
- Crop Yield Statistics
- Crop Disease Spray Planner
- Crop Yield Simulator
- Climate Smart Farming = traditional knowledge inventory
- Farm/Extension Diary
 - Data collection, analysis, visualization

**Web-based, mobile-compatible
Decision Support System**





Challenge 1 & 2. Sound, state-of-the-art science and technology-supported decision-making using climate services derived from stakeholder-driven portfolios

Conclusion

- **Comprehensive assessment of baseline climate services** (capability & capacity), and **multiple selection process** for the service options resulted in stakeholder-driven portfolios for the climate services
- **Sufficient communications** and **co-development of climate service with stakeholders** through participatory meetings and field trials assured **their ownership and credibility for the final outputs**, which encourages the application of the climate services for their decision making
- **Champion farmers** are doing trials such as intercropping and different planting dates using the crop simulation model by themselves
- **Market supply and price estimation using climate information** and **weather index-based insurance** are now the priority of MAFFF strategic plan for increasing climate resilience

Challenge 3. Improving agro-data management capacity and establishing data-oriented guideline for sustainable data management in MAFFF

- Past agro-data in a form of hardcopy
- Recent data mostly electronic files, but often missing as staffs rotate Dept.
- No guideline for data management



Development of an agriculture database

**Tonga Agricultural
Information System**
User Manual

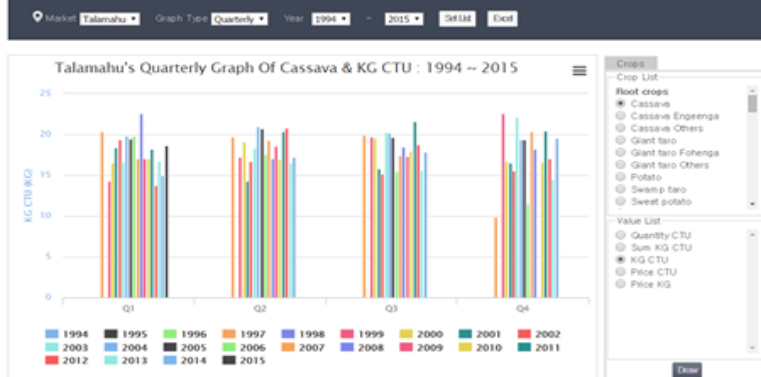


Tonga Agricultural information system

HOME | CONFIG | SYSTEM | LOGOUT

Weather observation
Annual Report
Census Data
Market Data
Import Data
Export Data
Scan File Management
Configuration

Market Graph

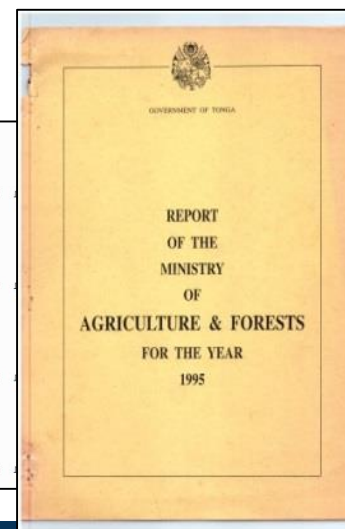


DB management system (TAIS)

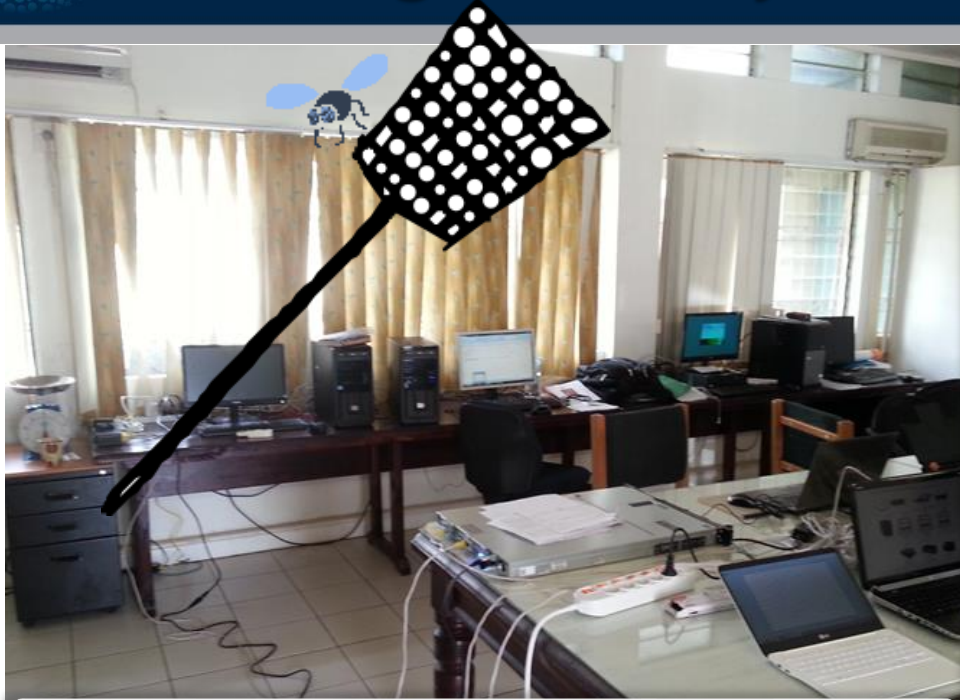
Scan File Management

Category: Select | Subject: | Search

Data No	Category	Subject
7	Annual Report	Annual Report 19
6	Annual Report	Annual Report 19
4	Annual Report	Annual Report 19
3	Annual Report	Annual Report 19
2	Annual Report	Annual Report 19
1	Annual Report	Annual Report 19



Sustainable use of the agriculture database management system, TAIS



1 Training on digitization and DB management system



Meetings to explain the importance of DB management 2



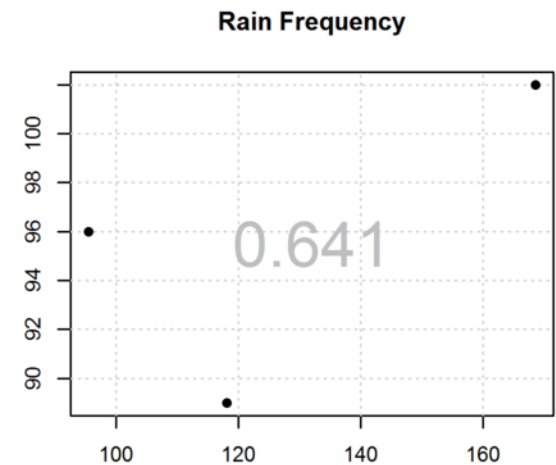
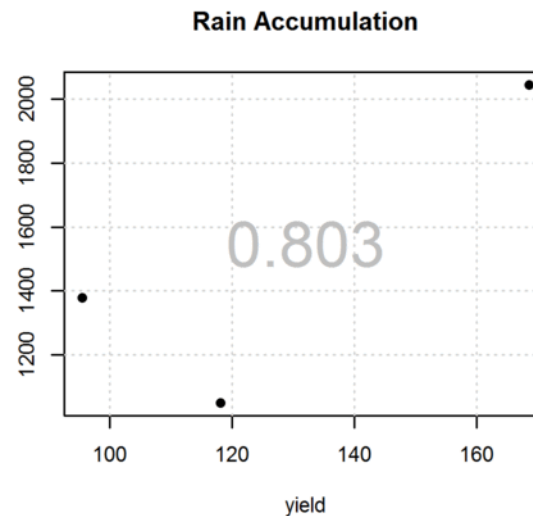
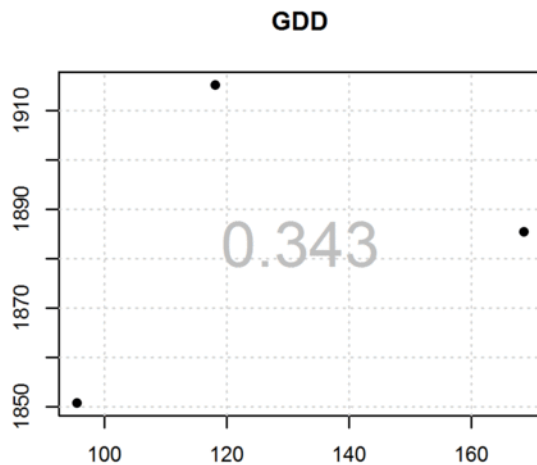
3 Meetings with high level officials (Ministers)



Sustainable use of the agriculture database management system, TAIS

- **Why we need the standardized, mainstreamed collection and use of long-term, quality-controlled agriculture data ?**

*** Big data analysis : Statistics**



Ministry guideline for data management established in MAFFF

Serious...
We shouldn't
give up DB



What is
"DB"
looking
like?

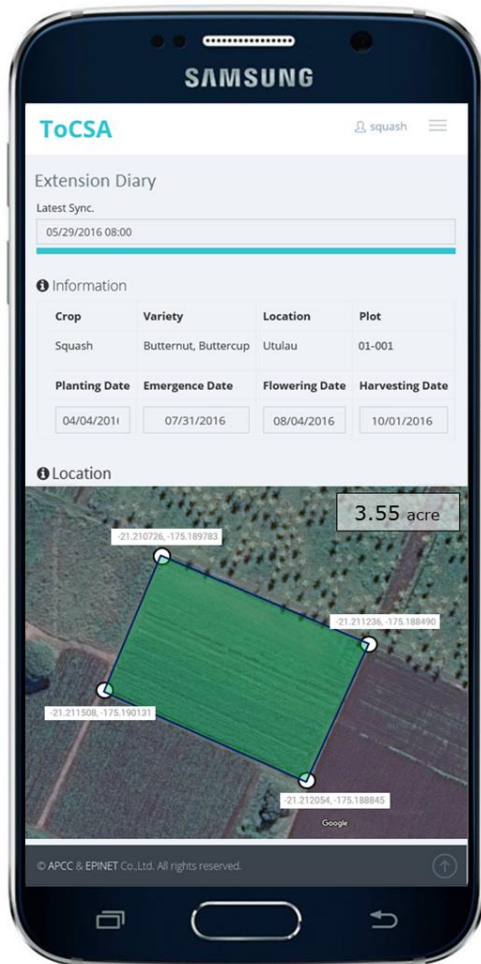


**Multiple trainings
for TAIS!**

*"we will never forget
this is the must task,
Must continue!"*

Guideline extended to a new task on agro-data collection and management in MAFFF

Extension Diary



→ Extension Diary is an ICT Extension Tool for

- 1) **Collecting** agriculture data with geospatial information
- 2) **Analyzing** the collected data in various temporal/spatial scales to get essential statistics
- 3) **Visualizing** the agriculture data on the map for a management purpose

→ Extension Diary is utilized not only for the Annual Crop Survey once a year but also for regular (weekly or monthly or seasonally) crop surveys by extension workers or farmers

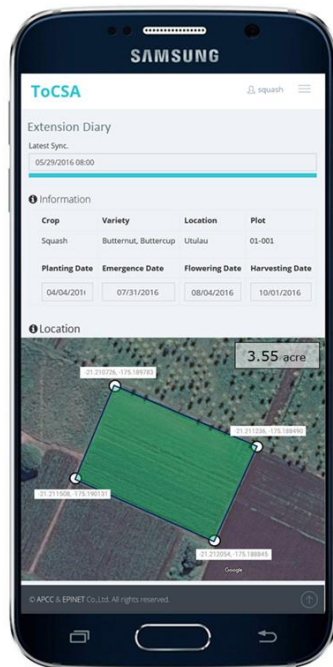
→ Collecting Information

- (1) Crop, Variety, Grower, Cropping type
- (2) Planting, Emergence, Flowering, and Harvesting Dates
- (3) GIS info with a map (Coordinate)
- (4) Number of Seeds applied and/or Final Yield

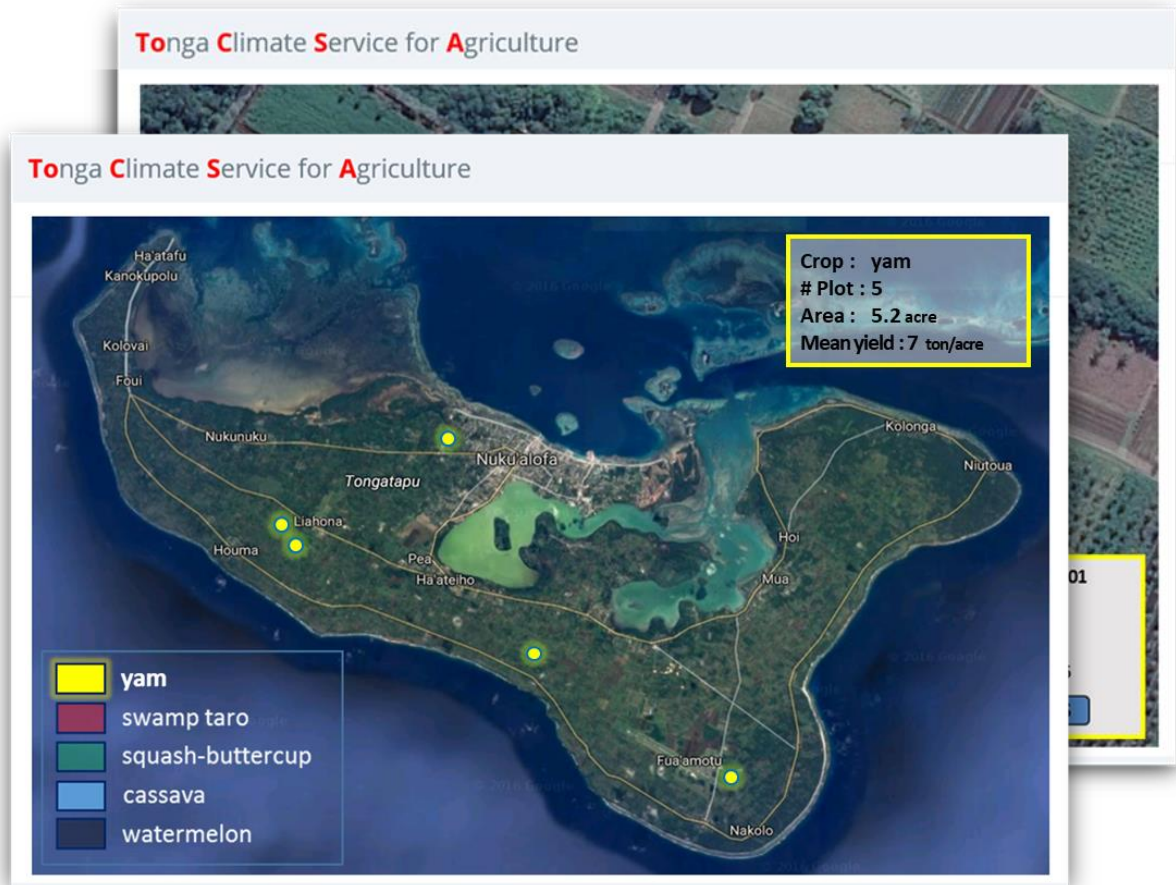


Extension Diary consists of **two** components

A mobile device application for offline data collection



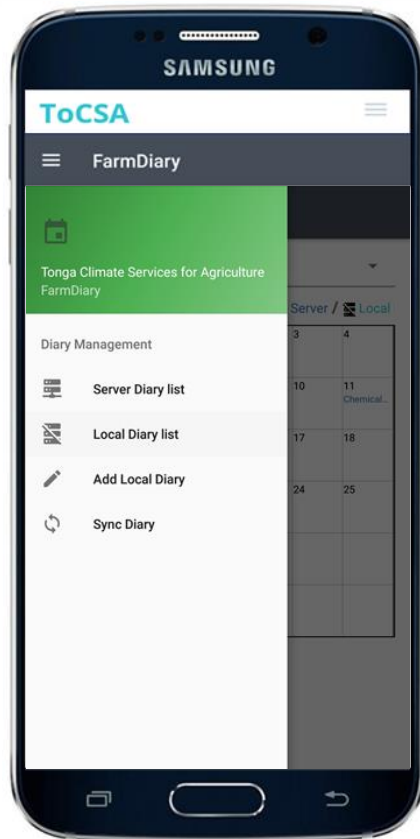
A desktop analysis and GIS-based visualization using a web-based Extension Data Management System on ToCSA



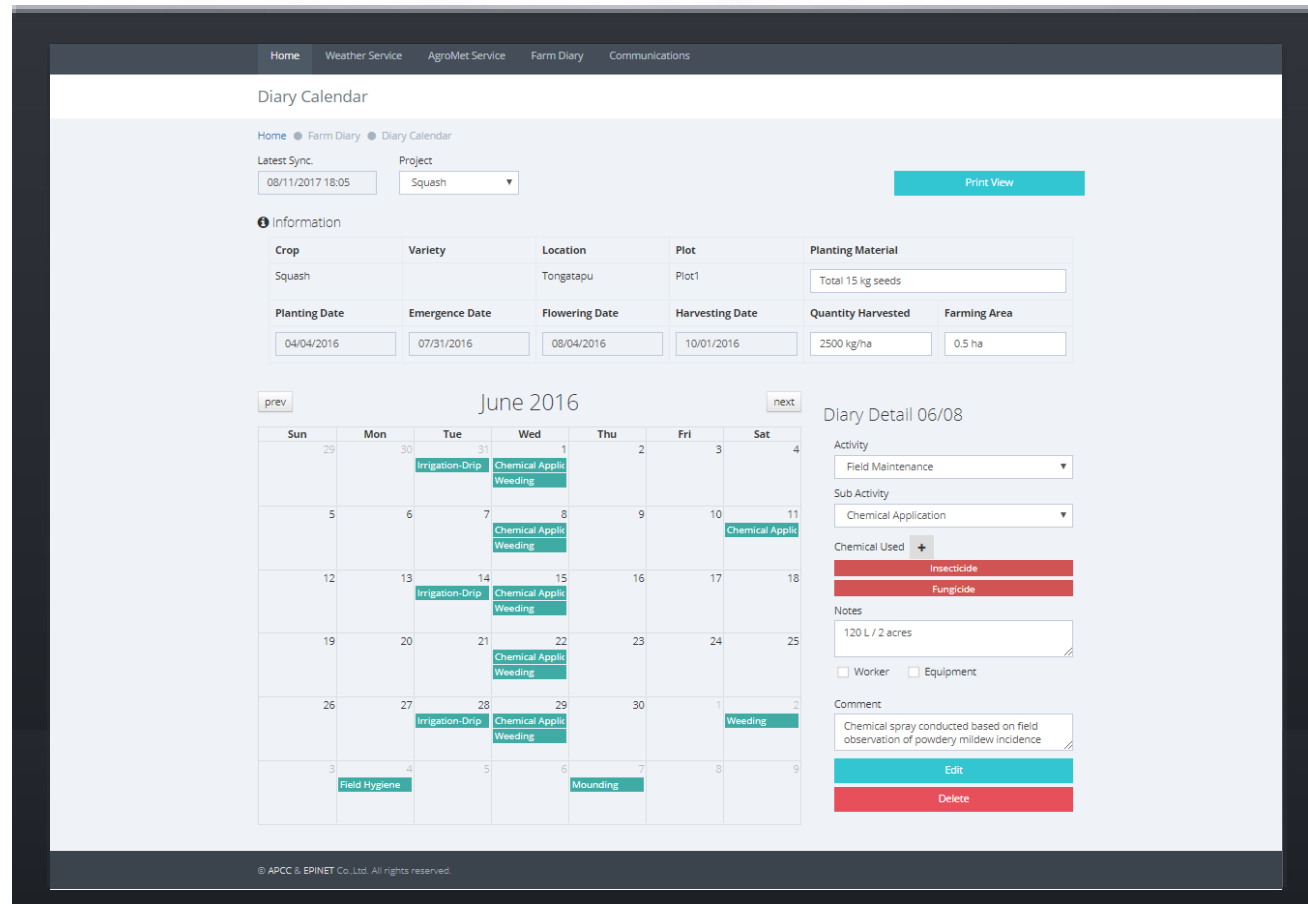


Commercial Farmers join agro-data collection in their farm management

A mobile device application for offline data collection



A desktop analysis and management tool on ToCSA





Challenge 3. Improving agro-data management capacity and establishing data-oriented guideline for sustainable data management in MAFFF

Conclusion

- Tonga Agriculture Information System (TAIS) is now an **official DB management system in MAFFF**; It is now **mandate to upload** market survey, export and import, and regular reports (Annual Crop Survey, FAO Census, etc) into TAIS
- MAFFF is going to collect monthly agro-data focusing on major cash and staple crops using the Extension Diary based on **the MAFFF data management guideline**
- **Champion commercial farmers** are using Farm Diary to collect their own agro-data and for their compliance document for export
- **Local NGOs** are planning to develop their own Extension Diary to use in a community level data collection for baseline and future disaster impact assessment

Challenge 4. Reaching out as many end users as possible up to community level

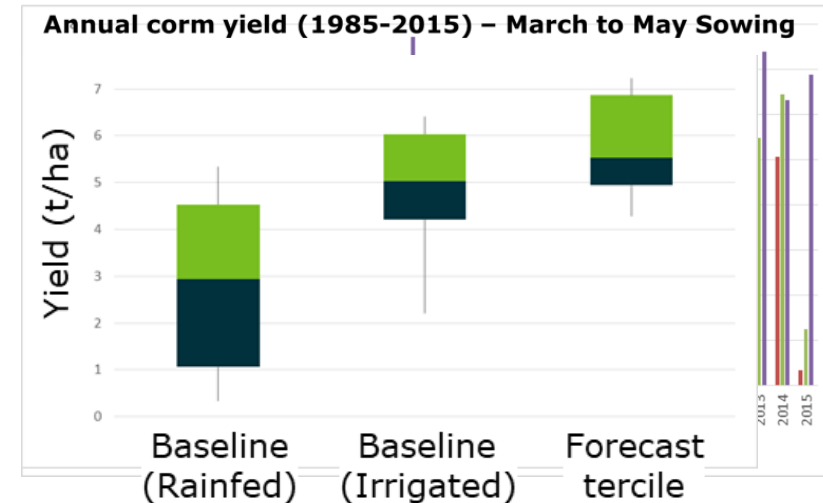
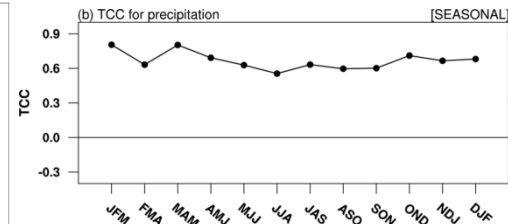
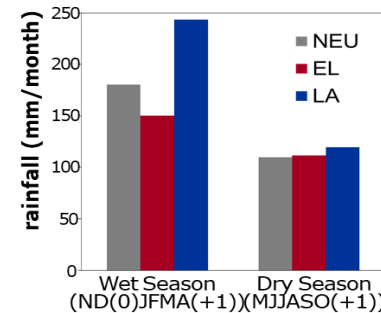
- Collaboration with local NGOs and champion farmers



- Reaching out villages with ToCSA to provide essential weather and climate information
- ToCSA as one of the community adaptation strategies to climate change

Applied climate education to convince farmers

- Understanding the probabilistic nature, and reliability and limitation of climate forecasts
- Understanding the potential benefits of using climate forecasts in crop management
- Identify decision points in farm activities using climate information
- Learn why we need quality agro-data and how to utilize available agriculture and climate information
- Country-specific, local context-based climate change impact results (present and future)



Various ways of information dissemination

- Web-based/mobile-compatible system
- Regular agro-met advisory email
- TV and radio advertisement
- Agro-met advisory handout
- Push alarm via mobile-device application
- Face-to-face trainings and fora
- Education material for Farmer Field School



Communication materials

Building agricultural resilience with climate services

APEC Climate Center

As a hub of climate science and application activities in the Asia-Pacific, APCC provides optimized climate information and technology for the region and beyond. APCC strives to contribute to safer and more resilient communities through innovative research, operational products and services, and capacity building in the field of climate science and its applications.

Tonga AgroMet Project

Project Overview

The project, which is one of many collaborations between the APEC Climate Center (APCC) and the Government of the Kingdom of Tonga, runs from August 2014 to December 2016 and focuses on building capacity and linking the agriculture and meteorological sectors to develop critical climate service for agriculture.

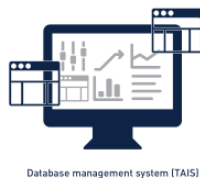
Components

1. Stakeholder and user needs assessment
2. Development of the **Tonga Agricultural Information System (TAIS)**
3. Research on the core relationships between climate and agriculture through modelling and field trials
4. Development of the **Tonga Climate Service for Agriculture (ToCSA)**

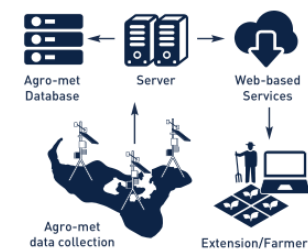


Tonga Agricultural Information System(TAIS)

A comprehensive database was developed to bring together climate, agriculture, market and crop yield statistics. The **Tonga Agricultural Information System (TAIS)** is a customized portal and forms a core component of the Tonga AgroMet Project. This information can now be used for climate services, enabling farmers and extension workers to understand the relationship between climate and crop production. **TAIS** is maintained and updated by MAFF for agricultural database management.



Agromet Network



Tonga Climate Service for Agriculture(ToCSA)

ToCSA is a web-based, mobile-compatible decision support system, designed to support Tongan farmers in managing and planning for the impacts of climate variability on their crops and livelihoods. **ToCSA** hosts multiple agro-climate services to provide:

- Weather and climate information: historical data, warnings, weather and seasonal forecasts
- Seasonal crop phenology and yield prediction
- Crop pest risk management
- Planting date and irrigation decision support
- Climate smart farming knowledge integrated with seasonal forecast
- Farm Diary to track farm choices, including planting and the use of pesticides, and generate export certificates



FACTSHEET

FEATURES

Tonga Agricultural Information System (TAIS)
 → A customized agricultural database to bring together climate, agriculture, market, and crop yield statistics
 → Used for agricultural database management by Tonga MAFF

Weather & Climate Forecasts
 → Weather forecasts with severe weather warnings
 → Seasonal forecasts for long-term agricultural decision making
 → Includes the probability of major seasonal climate phenomena such as El Niño and La Niña

Weather Analysis
 → Real-time weather information
 → Historic climate data analysis
 → Agromet index calculation

Pest Spray
 → Crop disease risk forecast for timely spray based on weather forecasts

Crop Supply Statistics
 → Market supply estimation for major crops based on ENSO forecasts

Crop Management
 → Crop management options with yield probability information using seasonal climate forecasts
 → Recommendations to aid complex agricultural decision making

Farm Diary
 → Personalized diary available to track farm choices including planting and use of pesticides or fertilizer
 → Links to smartphone application with offline use and online updating
 → Used for the export certificate



Challenge 4. Reaching out as many end users as possible up to community level

Conclusion

- Collaboration with local NGOs and champion farmers resulted in better awareness about ToCSA, and more stakeholders getting weather and climate information through ToCSA
- This is an **ongoing process with huge potential** as more collaborations and follow-up projects are realized
- As more users understand the climate services for agriculture **through educational opportunities**, more end users in community can be reached out
- **Continuous update (with funding) of the system** will ensure the continuous interest on and the use of ToCSA by stakeholders

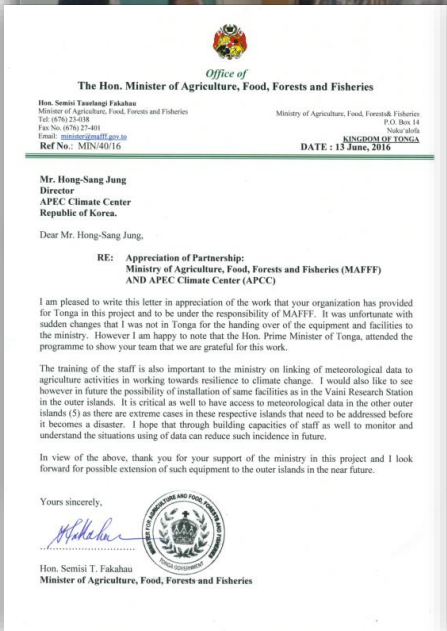
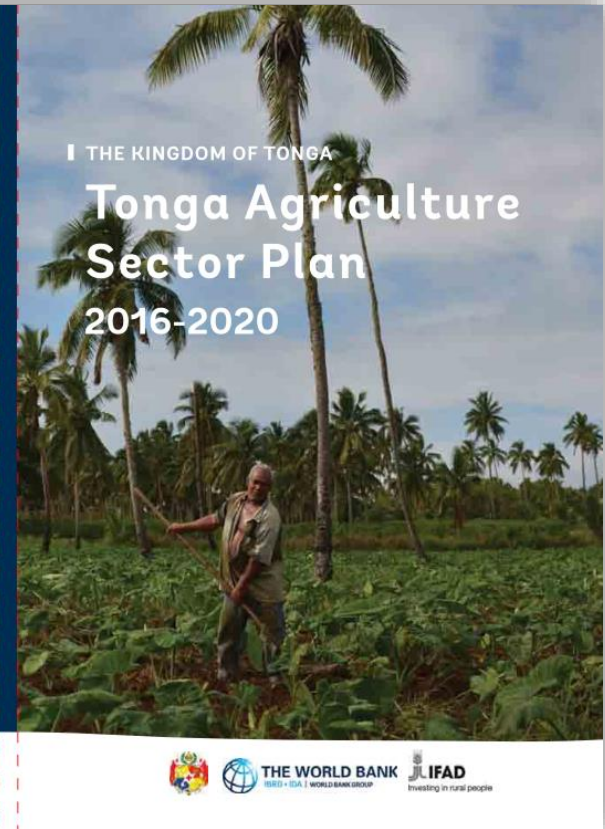
Challenge 5. Mainstreaming the climate services for agriculture to increase long-term sustainability

- Handover and operation agreement for TAIS and ToCSA
- Joint-agreement for agro-met station maintenance



Contribution to the Tonga Agriculture Sector Plan (TASP)

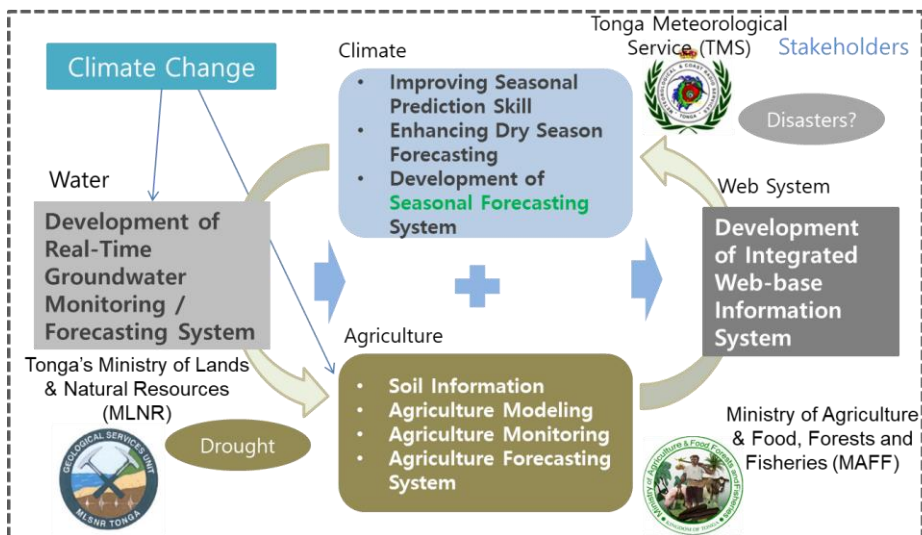
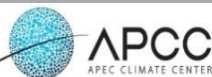
- Through the AgroMet Working Group, climate services for agriculture suggested as a major adaptation plan to climate change and variability



← Letters acknowledging ToCSA as a means for climate service for agriculture in both Ministries

Projects implementing major components in TASP through ToCSA are under way

● Tonga Agri-Water Project



● ROK-PI CliPS Project



- ✓ Seasonal forecasts produced by PICASO will add value to ToCSA in providing climate services for agriculture

● ADB Climate Resilience Sector Project



- ✓ Dense AWS network installed over Tonga and connected with ToCSA to provide location-specific climate services for community
- ✓ Reference stations for the preparation of weather index-based insurance as a future risk management option

● IFAD Tonga Rural Innovation Project



- ✓ Farmer Field School uses ToCSA as a means for climate information delivery and educational material for Tonga rural communities
- ✓ Baseline community data collected and managed using the Extension Diary on ToCSA

Intensive trainings for ToCSA users and system operators

Tonga Climate Service for
Agriculture
Admin Manual



ToCSA Workbook

ate Service for Agriculture (ToCSA) Training and Workshop
2017

"How useful or helpful is the ToCSA in your farming or extension work?"

"Yes, help in teaching FFS next year. ~. Young farmers can find information or data more easily and quickly of any kind of crops" (Viliami Soakai)

"The farm diary will help us keep accurate records of our production" (Ella Kafalava)

"Tongan climate service helpful, CSA very helping working planting for everyday every week too" (Suliana Nightigate Fate)

"Yes, it contributes in develop our knowledge for farming and easy access to the farmer the relevant time for cropping. To know worst time to the farmer and their farm and somehow to overcome." (Mofuike Famgupo)

"Yes, very helpful because the decision making for farming is defend from the wealthier and climate forecast data. Need not to complete want to minimise risk. We also need to improve from data we collect such as export and also and for farmer but if the ToCSA affected that it delay or minimise of want." (Futa lolo)

Increasing the awareness of ToCSA to international communities

WB K-Developedia

WMO Bulletin

Case Study: Improving Agricultural Productivity in Tonga

The APEC Climate Center (APCC) is currently developing a forecasting system that takes the unique geographical characteristics of the Pacific Islands into consideration. This system will serve the main APCC portfolio in the Pacific Islands: climate change adaptation in agriculture, water management and health, among others. A joint GFCS/APCC project in Tonga offers an example of how agricultural productivity can benefit from climate data and enhanced agro-meteorological services.



The 2014 drought destroyed 80% of squash harvests in Tonga

The project, launched in 2014, has four components: assessment of user needs and capacities, development of an agricultural database, research on the core relationships between agriculture and climate through modelling and field trials, and the development and delivery of agro-meteorological services. The envisioned outputs include 2-7 day warnings for pests and diseases, a suite of tools supporting farming in decisions on planting dates and crop varieties, and other advisory services derived from seasonal climate forecasts.

It aims to deliver climate information services for Tongan agricultural growers and exporters at a time of great urgency. The 2014 drought destroyed 80% of the squash harvest, a main export crop from which the country derives foreign exchange earnings. The project team hopes that growers and exporters will manage future climate risks better with the right tools and services in place.

The project has already achieved its first milestones:

- an automatic weather station in the MAFF Research agro-meteorological place in Tonga;
- an agricultural database that houses and archives developed;
- coordination meetings alignment of the project Tongan government and
- rigorous scientific research field trials, have addressed support the economy and

Other high-value export crops for local consumption primary target crops for the through state-of-the-art agriculture on the findings from this project tools will be developed to knowledge that supports domestic and exporters as well as bring the Tongan government.



Tonga Climate Service for Agriculture

On 22 July, APCC signed a standing with the government cooperation and facilitate research outcomes. This project its knowledge and experience and services with the government cope with climate change, will cooperate in turn with change related information use outcomes from the Tonga

Contributed by Kwang-Hyung Kim, The APEC Climate Center

K-Developedia and Knowledge Hubs series 13 – To... | Collaboration for Development... 1의 3페이지

K-Developedia and Knowledge Hubs series 13 – Tonga Meteorological Services & APEC Climate Center

2015. 12. 30 오후 5:10에 JEE EUN SUNG님이 만들었으며, 2016. 1. 5 오전 9:36에 JEE EUN SUNG님이 마지막으로 수정했습니다.



K-Developedia and Knowledge Hubs Series
Peer-learning from Korean Institutions
K-Developedia

Dear CoP members,

We proudly introduce the 13th engagement of the K-Developedia Series. Today, I shared how Tonga could cope with climate change and improve agricultural productivity. established in 2005, is an institutionalized communication channel based in Busan.

1. Could you briefly tell us about your institution and what you do?

Tonga has a meteorological service, which is comprised of six manual stations measuring meteorological phenomena on land, on the ocean, and in the atmosphere to collect meteorological data. As the Director, I am managing the activities of the Tonga Meteorological Service.

The Primary industrial sectors of Tonga are agriculture, fisheries, and tourism. The crops exported to Tongans who live overseas, particularly in Australia and New Zealand, the role of the Meteorological Service is becoming more and more important in the future.

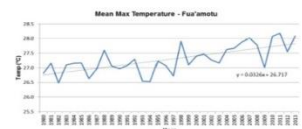


Ofa Fa'asumu, Director of Meteorology, Tonga (TMS: Tonga Meteorological Service)

2. Could you introduce what Tonga has learned from other agencies through the project?

While attending the 2013 APEC Leaders' Summit in Bali, Indonesia, President Gonsky (PCC) in a side meeting. At this meeting, President Park noted that sea level rise and to mitigate this impact she announced that the APEC Climate Center (APCC) variability and change.

Currently, APCC is developing prediction techniques and a forecasting system that carrying out climate change adaptation projects to meet the needs of the Pacific Islands. Tonga's economy is dependent on weather and climate sensitive sectors. One meteorological record indicates a rising trend in the average maximum annual temperature.



WMO GFCS



GFCS GLOBAL FRAMEWORK FOR CLIMATE SERVICES

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[Home / Projects / Contributing Projects / Improving agricultural productivity in Tonga by enhancing data availability and agro-meteorological services](#)

Improving agricultural productivity in Tonga by enhancing data availability and agro-meteorological services

[Overview](#) [About the Project](#) [Partners](#)

The aim of this project is to improve agricultural productivity in Tonga by enhancing data availability and agro-meteorological services

Pillar:
Research, Modeling and Prediction

Benefits:

- Considering the relatively low levels of technology, infrastructure, and economic development of Tonga, the project provides practical support to solve these issues.
- Capacity building to improve basic skills and essential infrastructure in agricultural sector to enable Tonga to more independently cope with climate variability and change.
- In line with the GFCS, this project delivers climate services to agricultural areas in Tonga, which may result in an international recognition of this project as a model case for the GFCS.
- forecasts developed through this project with information about crop yield and diseases/pests of certain crops can be used to assist stakeholders including policy makers, extension workers and farmers in timely decision-making, and to enhance Tonga's agricultural climate resilience.

Activities:

1. Assessment of users' needs and capacities
- 1.1. Begin initial discussions with stakeholders
- 1.2. Conduct inception workshop to identify needs and capacities of users



Challenge 5. Mainstreaming the climate services for agriculture to increase long-term sustainability

Conclusion

- **Official agreements** with and between Tonga government are required for the mainstream use of ToCSA as a means for climate service for agriculture
- **Utilizing national policies/plans** such as the Tonga Agriculture Sector Plan (TASP) facilitates the mainstream use of ToCSA; In fact, the climate information service through ToCSA is recognized as one of the priority climate change adaptation plans in TASP
- **Connecting ToCSA with follow-up and existing projects** ensures continuous use of ToCSA and thus allow periodic updates of the system leading to sustainable, viable services for Tongan stakeholders
- **Continuous training and exposure** of ToCSA to users and operators resulted in positive influence to users and committed operation by operators



Lessons Learned

1. Climate service should be based on stakeholder-driven portfolios
2. Decision makings using the climate service should be supported by sound, state-of-the-art science and technology
3. Improving agro-data management capacity can be realized with the establishment of necessary guidelines for sustainable data management
4. Best ways to reach out as many end users in communities as possible should be sought
5. Mainstreaming the climate services for agriculture increases long-term sustainability

Tonga Climate Service for Agriculture

Kwang-Hyung Kim | kh.kim@apcc21.org | www.apcc21.org



(Photo from <http://rhlgroup.com.au/>)

Time Series

7 Day

Seasonal

Thank you for your interest on climate service~!! ☺

Time	Weather	Temperature	Humidity	Wind
6PM 03	☁	Cloudy	☹	E Light
9PM 03	☁	Cloudy	☹	E Light