



**PACIFIC EUROPE NETWORK
FOR SCIENCE, TECHNOLOGY and INNOVATION**

D5.2 Report on the use of the seed funding

**Deliverable 5.2
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Background and rationale of the Seed funding scheme

The Pacific-Europe Network for Science, Technology and Innovation project (PACE-NET Plus: <http://pacenet.eu/>) supports the EU-Pacific policy dialogue and cooperation, for addressing a number of major societal challenges: health, demographic change and wellbeing; food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bioeconomy; climate action, resource efficiency and raw materials. With the aim to promote the implementation of joint activities, support innovation, and strengthen Pacific-EU research cooperation and partnerships, PACE-NET Plus is offering seed funding to support initiatives intending to enhance collaboration and innovation.

Proposals had to address one of the Societal Challenges above and to identify how the proposed initiative would contribute to leveraging further funding, initiating further collaboration, and/or generating innovation.

This scheme has been very useful to enable and encourage Pacific and European researchers to network and to set up collaborative projects, to fill in scientific gaps and making use of knowledge exchange capacities; and to implement joint activities in order to support the cooperation which were established during the Think Tank events in Bremen (Germany), Papeete (Tahiti), Nouméa (New Caledonia), Auckland (New Zealand).

The Process

The call was launched in April 2015 for the three societal challenges above.

The call was open to applicants from EU countries (including OCTs), Australia, New Zealand and Pacific Island Countries and Territories. Participants from Australia and New Zealand were eligible but only if the proposal involves an EU and PICT partner. Proposals had to be joint applications between the two regions, with at least one partner from Europe and one from the PICTs involved. Australian and New Zealand partners could also be associated with any application and receive funding.

Proposals could involve joint calls, summer schools, twinning and networking of (private or public) labs or organisations (including regional ones) etc.

Up to 10,000 EUR have been granted per successful project and all research stakeholders from the South Pacific/Europe were eligible to apply. Funds could cover consumables, travel funds and other project-related costs but could not be used to cover personnel costs. The overall project budget dedicated to this seed-funding scheme was approximately 160 000 Euros, distributed among 16 projects that have been finally conducted.

The proposals have been evaluated by thematic experts with good knowledge of the Pacific, assigned by the PACE-NET Plus project consortium. Proposed projects had to be new and not be part of an ongoing established cooperation. Preference was given to applications with greatest potential to support PACE-NET Plus goals and that were to be further funded

or those with greatest potential to generate significant innovation. The selection took into account the alignment of the proposal with the call objectives and the predicted chances of initiative success and impact.

Response was overwhelming

Out of 65 proposals submitted, 21 proposals were selected and 17 have been finally conducted and granted funds.

The areas of topics submitted were very diverse (solar energy, deep sea mining, observing systems, sustainable transport, science policy development process, indigenous approaches to agriculture, pollution and human health, algae bloom, fish poisoning, etc.) and so were the instruments suggested (workshop, consultations, risk assessment, community-based project, collaboration project between different stakeholders, capacity development in the area of leadership).

From Fiji, Papua New-Guinea, Samoa, Tonga, Pitcairn, to New Zealand, Australia in the Pacific; from Germany, England, France, Austria, Norway and Denmark, to Spain, in Europe... the participants to the call originated from many countries in both regions.

The proposals also involved a great diversity of research organizations, universities, but also entities from the private sector, as well as governmental bodies (see the list of successful projects hereafter).

List of selected projects

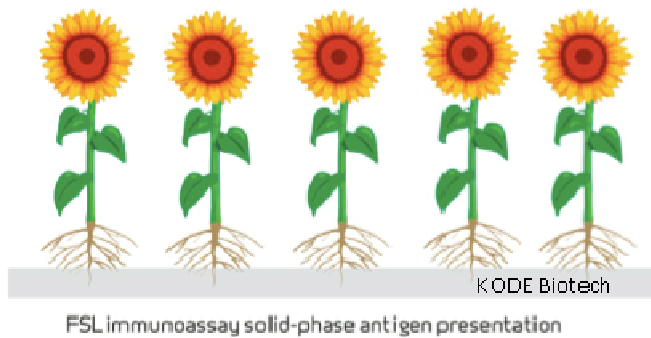
WP # 1	Topic	Project leader	Other organisations involved
Infectious Diseases	Nano-bio-surfacing & Diagnosis of infectious diseases	Pasteur Institute in New-Caledonia IPNC (NC)	Auckland Univ. of Technology-AUT (New Zealand); DIaGRON (La Réunion); Institute of Medical Research of Papua New Guinea (PNG)
Non communicable diseases	Physical activity for today's Oceania youth	University of New Caledonia-UNC (NC)	MPT Innovation Group (Australia); Univ. of Sydney (Australia); Matuaileoo Environment Trust Inc. (Samoa); MSH Medical School Hamburg (Germany); Institut de Recherche pour le Développement (France); Bergmans Iati (Vanuatu)
NCDs	Monitoring non-communicable disease (NCDs) mortality in Pacific Island States	University of New South Wales (Australia)	INSERM. IPLESP, UPMC, EPAR (France) ; Ministry of Health, Government of Fiji (Fiji); Univ. of New Caledonia, Noumea (New Caledonia); Secretariat of the Pacific Community (Region.)
WP # 2	Topic	Project leader	Other organisations involved
Agri-Aqua-culture	The Role of Geospatial Information for Assessing Environmental Livelihood Security in the South Pacific	University of Sydney (Australia)	Univ. of Southampton (UK); Univ. of Stirling (UK); The Univ. of the South Pacific (Reg.); Univ. of Auckland (New Zealand); Univ. of Western Australia (Australia)
Agri-Aqua-culture	Evaluating the sustainability of deepwater snapper fisheries in the Pacific region	Secretariat of the Pacific Community-SPC (Region.)	Institut de Recherche pour le Développement - IRD (New Caledonia); National Institute of Water and Atmospheric Research-NIWA (New Zealand); James Cook Univ. -JCU (Australia)
Agri-Aqua-culture	Pacific Food Matters: converging traditional knowledge solutions with ecological science for climate resilient local and global food security	New Zealand Council for Educational Research (New Zealand)	Pacific Organic and Ethical Trade Community (Fiji); New Caledonian Agronomic Institute (New Caledonia) ; Chambre d'Agriculture (New Caledonia); Alfred-Wegener Institut (Germany); Ministry of Environment, Lands and Agricultural; Development (Kiribati); Victoria Univ. Wellington (New Zealand)
Lagoon health/Cig.	Pilot inventory of traditional knowledge of ciguatera fish poisoning and its treatment in the Pacific Island region; Fiji and PNG	The University of the South Pacific (Reg.)	The Univ. of Papua New Guinea (Papua New Guinea); CEA-LTMB Molecular Toxicology & Biotechnology lab.(France)
Lagoon health/Cig.	Improving the knowledge base for ciguatera monitoring and protection of public health and local economies in OCTs, Pacific Island Countries and Territories, Australia and New Zealand	University of Copenhagen (Denmark)	Institut Louis Malardé-ILM (French Polynesia); Institut de Recherche pour le Développement (New Caledonia & Tahiti); Marshall Islands Marine Resources Authority (Marshall Islands Authority)
WP # 3	Topic	Project leader	Other organisations involved
Natural Resources	Consultations for a Pacific Network for Social Responsibility and Natural	Secretariat of the Pacific Community (Region.)	Institut de recherche pour le développement-IRD (New Caledonia); Pacific Social Mapping Pty Ltd (Australia)

	(Mineral and other) Resources		
Climate action	Kuchuwa Community Project: Indigenous Youth Responses to Water and Waste Management	Micronesian and Australian Friends Association- ANU (Australia)	Chuuk Youth Council-Kuchuwa (Fed. States of Micronesia); Univ. of Heidelberg (Germany); Albert-Ludwigs-Univ., Freiburg (Germany)
Climate action	Pre-feasibility study for methane recovery at Naboro landfill, Suva, Fiji	The University of the South Pacific (Reg.)	NV Afvalzorg (Netherlands); National Institute of Water and Atmospheric Research-NIWA (New Zealand)
Natural Resources	Identifying risk assessment tools and approaches for deep-sea mining activities to support communities, government and developing industries.	Southern Cross University (Australia)	Seabed Minerals Authority (Cook Islands); Senckenberg am Meer (Germany); Chatham Rock Phosphate Ltd (New Zealand); NIWA (New Zealand); Griffith Univ. (Australia)
Climate action	Communication, communities and climate change: Designing a leadership program for community-based climate change practitioners in the Pacific region	University of South Pacific-PACE-SD (Reg.)	RMIT Univ. Melbourne (Australia); Foundation of the Peoples of the South Pacific Islands (Fiji & partners: Kiribati, PNG, Solomon Islands, Tonga, Tuvalu); Universitat Autònoma Barcelona (Spain)
Climate action	TPOS2020: Tropical Pacific Observing system for 2020 : first workshop for the backbone task team	CSIRO (Australia)	Institut de Recherche pour le Développement-IRD (New Caledonia); PI-GOOS/SPREP Apia (Samoa)
WP # 4	Topic	Project leader	Other organisations involved
WP1 Infect. Diseases/ Innovation	IDEA Consortium Workshop: Social-Ecological Modelling of Innovative Genetic Control Approaches to Mosquito-borne Diseases	Institut Louis Malardé-ILM (French Polynesia)	Univ. of French Polynesia (French Polynesia); OXITEC (French Polynesia); Univ. of Oxford (UK); CIRAD (France); AVIA-GIS (Belgium); ETH Zurich (Switzerland); CNRS (France); Univ. of Melbourne (Germany); International Atomic Energy Agency (UN in Vienna, Austria)
WP2 Agri-Aqua-culture /Innovation	Food-security and bio-security in Melanesia: land snails as pest agents of decline of self-sufficiency in healthy food production and potential for utilizing edible native snails	The University of the South Pacific (Reg.)	Technical Center for Agricultural and Rural Cooperation-CTA (EU); Land Care Research-LCR (New Zealand); Institut Agronomique de Nouvelle-Calédonie - IAC (New Caledonia)
	Topic	Project leader	Other organisations involved
Cross-challenges	Initiating a Science, Technology and Innovation (STI) Policy Development Process in the Kingdom of Tonga	Australian National University (AUS)	Ministry of Lands, Environment, Climate; Change and Natural Resources (Tonga); German Aerospace Centre-DLR (Germany)

Nano-biosurfacing & Diagnosis of infectious diseases

Grant Team: M. Dupont-Rouzeyrol (Institut Pasteur in New Caledonia, IPNC); C. Goarant (Institut Pasteur in New Caledonia, IPNC); F. Merien (Auckland University of Technology, AUT); S. Henry (KODE Biotech, AUT); Y. Abdad (Papua New Guinea Institute of Medical Research, PNG-IMR)

Introduction



This project was based on the implementation and use of KODE Technology, which consists of nano-biosurfacing constructs for rapid diagnosis of infectious diseases. KODE technology involves the synthesis of function-spacer-lipid (FSL) constructs and their insertion or attachment into/onto a large variety of biological and non-biological substrates (e.g. ranging

from cell and virus membranes through to synthetics such as plastic, filter paper, magnetic bead, etc.). Once optimized peptide/antigenic sequences for detection of pathogens are identified, FSL constructs are synthesized by conjugation of the biologically active component to a lipid via a spacer. The presentation of antigenic sequences on FSL constructs greatly improves the sensitivity of the test. In addition, the use of these FSL constructs is very flexible, e.g. they can be printed onto a paper with a desktop inkjet printer and used in a novel immunoassay that identifies reactivity through the appearance of alphanumeric characters. Further information and publications related to KODE Technology can be found at www.kodecyte.com.

Nowadays, the Pacific region is experiencing many infectious diseases issues. The number of outbreaks due to communicable diseases has increased in the past years as shown by the reports from the Pacific community (Pacific Public Health Surveillance Network <http://www.spc.int/phs/pphsn/>, WHO Western Pacific Region <http://www.wpro.who.int/en/>). These outbreaks were vector-borne diseases (as dengue, chikungunya and Zika but also malaria, etc.), zoonosis (as leptospirosis) and water- and food-borne diseases (as typhoid fever). These diseases are important causes of acute febrile illnesses and deaths in the Pacific region. Pacific Island Countries and Territories (PICTs) are spread across more than 33 million sq. km over the ocean. Communication and access to reference diagnosis is a real problem in the PICTs. Furthermore, due to isolation and limited resources, PICTs have difficulties to manage large outbreaks.

The diagnosis of these diseases, frequently based on clinical signs, can be confusing as most of them can be classified in the so-called “acute fever of unknown origin” (i.e.: main symptoms are fever, headache, arthralgia, myalgia, nausea, diarrhoea...). However, it is important, for example to clearly discriminate leptospirosis from dengue infection, in order to adapt the medical treatment (use of antibiotics against leptospirosis), clinicians need

rapid confirmation of their diagnosis. Very few Rapid Diagnostic Tests (RDT) are available and even fewer are demonstrating good specificity and sensitivity values.

The burden of disease and level of exposure of PICTs to infectious pathogens is underestimated. Improving the early diagnosis will allow Public Health authorities to adapt and improve their surveillance and capacity to manage outbreak. Within this proposal, we aimed to develop this RDT. This RDT will facilitate outbreak investigations due to zoonosis or water- or food-borne diseases. Identification of the source or way of contaminations will be handled more easily. A faster response to the outbreak or the cluster of cases could be implemented. In another way, this RDT would allow the surveillance of the disease in the vectors or animals. Early detection of the diseases in the reservoirs or the vectors would permit Health Authorities to anticipate the risk and adapt their responses to the pathogen detected.

Key Workshop Points

A two-day meeting was organized the 15th and 16th of June 2016 and hosted by AUT in Auckland, New Zealand. On the 15th of June, a meeting was organized between the partners (IPNC, AUT, KODE, PNG-IMR) of the project in order to review the situation of the project:

- State of the art
- Inventory of work already done (see Progress)
- Work plan for future actions
- Weakness/Strengthens.
- This first meeting has ended with a visit of AUT and KODE laboratories.

Then, a working group meeting took place at AUT on the 16th of June, 2016. Scientists from Australia, New Zealand, New Caledonia, Fiji and Papua New Guinea were present (Program in Annex). During this day, discussions were dedicated to:

- Infectious diseases in the Pacific region with a special focus on Leptospirosis and Zika virus diagnostic;
- Diagnostic organization in the Pacific region with a special focus on Fiji and Papua New Guinea and their interest in the possible benefits of validated RDTs;
- Process of diagnostic test development and validation
- The Kode technology and its applications with a special focus on the NiDiPac project
- Ethics procedure relating to the use of human samples in research and development.

Project Outcomes

At the end of the workshop, the following were agreed as the meeting outcomes:

- Importance of enhancing partnerships in the region and outside
- Interest of the technology used: Innovation
- Importance of a proper validation of the test developed.

Progress after the Workshop/Future goals

Development of a RDT using the KODE system and new antigenic peptides for leptospirosis

Regarding the recent epidemiological situation in the Pacific region and because of former collaboration between IPNC and AUT or PNG-IMR, we first wanted to focus our proposal on

arboviroses and leptospirosis. However, IPNC and AUT were already collaborating on a project funded by the Fonds Pacifique (“Implementation of a regional network on leptospirosis in a “One Health” approach), thus we have chosen to focus our project on the development of a leptospirosis diagnostic test.

Selection of leptospirosis antigenic peptides and construction of the KODE system suitable for the tests

Leptospiral antigenic proteins and peptide epitopes were identified and designed using peptide identification algorithm. Potential candidate peptides from peptide identification algorithm, most likely to be compatible with and successful as KODE™ FSL constructs were tested using FSL (Function Spacer Lipid) peptide selection algorithm. Peptides deemed suitable for FSL construction were built (Leptospira Kode™ constructs). Performed preliminary testing by agglutination reaction using Leptospira Kode™ molecules painted group “O” red blood cells and Leptospira MAT (Micro-Agglutination Test) positive serum samples received from IPNC and random archived samples as controls. This is actually in process with peptides LipL21, Flab B, Loa22, LigA, LigB and LIC1021.

Test development: Validation of the antigenic peptides used

The previous steps were developed using well-characterized sera from IPNC bio-bank. This consists of the realization of the MAT (Micro-Agglutination Test) which is the gold standard technique for the sero-diagnostic of leptospirosis and negative samples. Ethics procedures are already in place at IPNC allowing the use of such well-characterized serum.

Test validation: Specificity and sensitivity

For this purpose, PNG-IMR bio-bank will be screened using a commercial Leptospirosis ELISA kit. The screening is in process. Selected serum will then be tested by the MAT at IPNC and used for validation of the KODE system construction and the leptospirosis antigenic peptides selected.

Ethics procedure

Ethics approval in PNG is two tiered, where the first tier is by institutional ethics board (if present) and if approved it moves on to the Medical Research Advisory Committee (MRAC) of the National Department of Health. The study was approved by the PNG-IMR Internal Review Board on 14th April 2016 (approval number 1604) and currently being reviewed by the MRAC.

Ethics procedures are already in place at IPNC allowing the secondly-use for research purpose of such well- characterized serum.

Material Transfer Agreement is in process between IPNC, AUT and PNG-IMR.

Final PACE-NET+ meeting

The objectives of this bi-regional dialogue platform (Suva, Fiji, 2016) is to propose concrete joint activities to strengthen the sciences, techniques and innovation cooperation between EU and the Pacific Region, thus contributing to policy dialogue between the two regions. For this purpose, the Seed-Funding projects funded by PACE-NET+ and their outcome were presented during the 3 days meeting. The NiDiPac project (WP1 Health, Demographic Change and Wellbeing) was one of the projects invited.

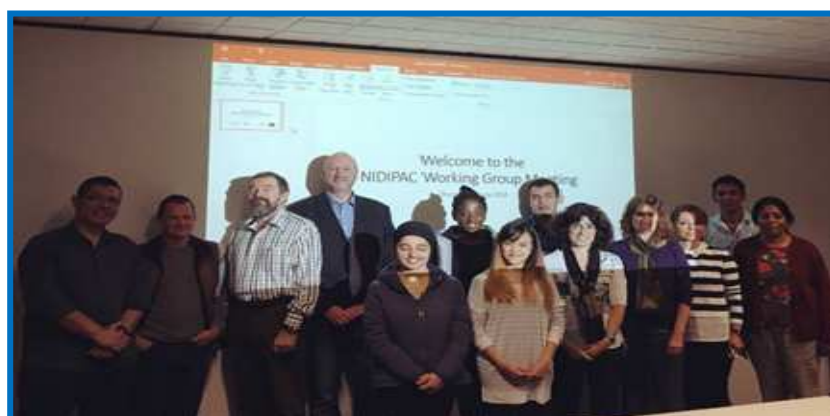
Impacts

The frequency of infectious diseases outbreaks is expected to increase in the coming years in the Pacific region as a result of increased air travel and climate change. Therefore, more trained response teams with the capacity to use up-to-date and efficient diagnostic tools for effective outbreak control are needed. This diagnostic tool may allow the development of a surveillance program for these diseases in areas at-risk. As this technology is highly and rapidly adjustable, this can also be applied to study the emergence of new pathogens in the region.

Lesson Learned

If the in-lab results obtained within this proposal are encouraging, a second phase of field test would be necessary. For this purpose, the meeting organized in Auckland aimed to promote other collaborations within the Pacific region. As this project is dealing with human samples and commercial tests, ethics procedures and collaboration contract are of significant importance. However potential to attract further funding is still in balance and a major concern regarding the extension of this project.

Photos & Figures



Physical activity for today's Oceania youth

Grant Team: University of New Caledonia-UNC (NC); MPT Innovation Group (Australia); Univ. of Sydney (Australia); Matuaileoo Environment Trust Inc. (Samoa); MSH Medical School Hamburg (Germany); Institut de Recherche pour le développement (IRD); (France); Bergmans Iati (Vanuatu)

Introduction

Over the past decades, a remarkable shift in lifestyles has taken place among the world's populations (WHO, 2012). The changes result from modernisation, rapid urbanisation and the globalisation of unhealthy lifestyle behaviours, each minimising physical exertion and creating unhealthy environments (Bauman *et al.*, 2009; WHO, 2010a). In today's global society, chronic diseases, also known as non-communicable diseases (NCDs), present a major threat to human survival and are causing more deaths than all other causes combined (WHO, 2010a). Four NCDs are the leading contributors to the global NCD epidemic: cardiovascular disease (CVD), cancer, chronic respiratory disease and diabetes (Pendersen *et al.*, 2006).

Despite its remoteness, the Pacific region has not been excluded from the global pandemic of NCDs. As of today, 75% of all deaths in the Pacific island countries (PICs) are attributable to NCDs (WPRO & SPC, 2007). Western influences have led to the dominance of commercialisation and consumerism, which in turn have had significant impacts on Pacific population health (Okihiro *et al.*, 2005). Obesity levels have reached epidemic proportions in some communities, and this situation is thought to be the direct result of modernisation and urbanisation, as observed by Okihiro in the Pacific islands in 2005.

Sometimes called 'lifestyle diseases', NCDs can be prevented but are nevertheless responsible for 36 million deaths per year worldwide (WHO, 2012). Among the behavioural risk factors, data show that tobacco comes first (6 million deaths per year) immediately followed by physical inactivity, with a toll estimated at 3.2 million deaths per year. Unhealthy lifestyles are linked to the development of cardio-metabolic risk factors, including high arterial blood pressure, overweight and obesity, and hyperglycaemia (responsible for 16.5%, 5% and 6% of the deaths, respectively).

It is now established that physical activity (PA) improves the social, mental and physical dimensions of health (Pendersen, 2006). In the domain of physical health, when associated with balanced food intake, physical activity (PA) can prevent the development of NCDs, including obesity, type 2 diabetes, kidney and respiratory diseases, and some cancers. Despite strong scientific evidence supporting the benefits of PA, data on the populations of the Pacific islands are scarce. We hypothesise that PA has declined to low levels in PICs through the Westernisation process and this decline now significantly contributes to the burden of NCDs.

Given that raising the level of PA is a challenge in all countries, we therefore propose to test the effectiveness of mobile technologies in PICs, as such technologies have shown encouraging results in other communities (Kurti *et al.*, 2015).

The 21st century can be seen as the century of mobile technologies, with internet access via smartphones, tablets, mobile computers, electronic bracelets, and connected watches. The

widespread dependence on these tools should be given greater research attention in the Pacific for the following reasons: (i) the younger generations today have ‘totally connected’ lifestyles. As researchers, we can make use of adolescents’ connected lives for both health and educational programmes; and (ii) the number of small islands in the Pacific, their limited financial resources, and the distances between them are all potential hindrances to the development of health education programmes. In this context, e-health, defined broadly as technology-supported health intervention, is an innovative approach to health research in the Pacific.

In this project, an interdisciplinary research team including experts in physiology, biology, anthropology, public health, medicine, education, and technology will identify the impact of different lifestyles, with a special focus on physical activity and food intake and the consequences for the physical (obesity, cardiovascular system, respiratory system, hypertension), mental (psychological aspects) and social (social relations) health of adolescents from the Pacific islands, *i.e.* Polynesians and Melanesians; the team will also determine how best to improve health education programmes.

OVERALL GOAL:

Reduce the incidence of NCDs in the Pacific by promoting physical activity and healthier behaviour in an e-health context

Key Workshop Points

During the seed funding period, and especially for the workshop, we identified the following key points:

- Before the workshop on innovation in telehealth and e-health, we participated at the telehealth conference (April 23 and 24, 2015, in Sydney).
- We have estimated the skills and contributions of each institution and the potential of an interdisciplinary research program.
- A feasibility study in New Caledonia (2015-2016) was conducted to test the validity of tools and set up a pilot study (presented below).
- The team wrote up a multi-nation programme for the future to adapt, implement and validate a similar approach in other PICs, with government agreements and two funding sources to finance this project.
- The project will be scientific and educational with a transfer from research to education to promote health behaviour patterns in adolescents.
- The project focuses on people (benefits to children and families), the environment (education, community) and/or associations at the end of the scientific programme.

Project Outcomes

At the end of the workshop, the following points were acted on:

1. Priority given to the diagnosis of overweight (measured data) and the assessment of physical activity levels (direct tracking) of Pacific youth. These actions will compensate the current lack of information in the literature on the Melanesian and Polynesian populations, as underlined by an NGO (SPC) present in the Pacific region. This will also

give us the opportunity to contribute to public health policies and to implement useful tools in the schools that will ensure longitudinal information for generations of young people everywhere in the Pacific. Please see the observations from The Lancet's physical activity observatory website <http://www.globalphysicalactivityobservatory.com>.

Planning a diagnostic and longitudinal approach in Samoa and Vanuatu (and other countries of the Pacific?) with the methodology used in New Caledonia in 2015 would be the first step of this international project.

2. Then, the development of e-health-based programmes to improve health and education in each of the Pacific countries according to the findings noted in point1. In association with:
 - All the lifestyle variables,
 - The environment of the adolescents including: friends, family, church, school, associations, local customs, etc.

Progress after the Workshop/Future goals

As presented in the figure below, we can see that some team members with expertise in physical activity, activity sensors and big data analysis started a project to pilot study in New Caledonia for 2016. This project is facilitated by a *Pacific Fund* grant obtained by the University of Sydney.

At this level, only part of the group is involved in the action. To develop a multi-national programme involving the entire team, we need to find substantial funds for the project. This was the message we delivered in Fiji. Indeed, we can represent the EU in the Pacific and opportunities will come in a first time from funds adapted to our team and project dimensions, with the aim to progress toward international funding (FED, H2020).

Impacts

The seed funding directly:

- Enhanced project visibility among New Caledonian institutions (SPC, governments: health, education, sport sectors) with the workshop organised in December 2015.
- Accompanied the team to an invitation to the "Inaugural University of Sydney Human-Centred Technology Research Symposium », 16 February 2016. 'Improving Health and Wellness through Digital Technologies'. We presented a part of the PACE-NET Plus project.
- The seed funding indirectly :
 - Accompanied the Pacific Fund grant of 30,000 Euros with the University of Sydney to develop a pilot study on Lifou Island (New Caledonia).
 - Strengthened relations with Industrial partners specialised in e-health (Bepatient), now implicated in the pilot study.
 - Strengthened relations with an Australian educational designer start up now implicated in the pilot study.

Lesson Learned

- The Islands of the Pacific Research Network needs to be continuously strengthened, which was mainly confirmed after the workshop.
- Applying for funds adapted to the size of our research team is a big challenge.
- Obtaining EU seed funding immediately raises our visibility in the big countries of the Pacific.

Photos & Figures

Figure below: a summary of the feasibility study around the PACE-NET Plus Workshop, the pilot study financed by the Pacific Fund grant, and the possibilities to develop this project throughout the Pacific in the future.



Appendix: press release on the workshop in Les Nouvelles Calédoniennes, 10.12.2015

6 **NOUVELLE-CALÉDONIE** jeudi 10 décembre 2015

> A noter

- > **L'Association nationale des anciens fonctionnaires de l'Aviation civile et de la météorologie nationale (Anafacem)** tiendra son assemblée générale le lundi 14 décembre, à 10 heures, au CNC. Tous les retraités de l'Aviation civile et de la météorologie y sont conviés. Contact : 85 2812.
- > **L'Association Pkikini Nouvelle-Calédonie** envisage de changer de dénomination pour ne pas être confondue avec le festival Pkikini ou avec l'association du même nom au Vanuatu. Vos avis sont les bienvenus sur pkikini.nc@gmail.com. Site : www.pkikinicaledo.com
- > **La réserve de la Marine** recrute. Quel que soit votre statut dans le secteur civil, que vous ayez un passé militaire ou déjà suivi une préparation militaire, l'antenne pour l'emploi des réservistes de la Marine nationale vous attend à la base navale de Chaleix, où elle est installée depuis le 23 novembre. Contact : 29 28 65 ou par e-mail à : aper.nc@gmail.com
- > **L'Office national des anciens combattants et victimes de guerre** informe que les personnes ayant servi 120 jours en opération extérieure peuvent obtenir la carte du combattant. Contact : 27 28 77 ou oacv.nc@carl.nc
- > **La Croix-Rouge française** recherche des bénévoles pour aider au tri des dons, quelques heures par semaine. Contact : 27 2176. E-mail : crf.secretariat@mls.nc.
- > **Initiative NC**, organisme d'aide à la création et au financement d'entreprises, recherche des bénévoles (toutes disponibilités et compétences) pour le soutien de ses actions et l'accompagnement des porteurs de projets sur la Grande Terre et les îles. Contact : 24 40 14. Email : contact@initiative-nc.com

Applis et bracelets connectés pour jeunes trop sédentaires

SANTÉ. L'activité physique de la jeunesse océanienne est un outil de lutte contre les maladies non-transmissibles. A l'Université, on s'est penché sur un angle d'attaque : l'utilisation des nouvelles technologies.

« **L'**activité physique pour la jeunesse océanienne d'aujourd'hui ». Tel était l'intitulé des journées d'étude organisées en début de semaine à l'Université. « Le secteur de l'activité physique est intéressant pour ses bienfaits sur le corps, l'esprit et l'environnement social des jeunes. C'est un bon bras de levier dans la lutte contre les maladies non-transmissibles*, à long terme », pose Olivier Galy, responsable du Lire (Laboratoire interdisciplinaire de recherche en éducation), jeune entité de l'Espé, dont l'un des axes de recherche se concentre sur « les modes de vie et la santé de la jeunesse en Océanie ».



ÉTUDE PILOTE À LIFOU
Financée par le programme européen Pace-Net Plus, dont l'objet est de stimuler les connexions scientifiques dans le Pacifique, la rencontre s'appuyait en grande partie sur le travail du Lire, qui exploite les nouvelles technologies. « Comme la jeunesse d'aujourd'hui est très centrée sur le monde connecté, il y a là un moyen de connaître son activité physique, avec les bracelets connectés, les applications sur smartphone, les réseaux sociaux... » Après avoir posé un diagnostic sur les trois provinces cette année, le Lire veut pouvoir proposer un programme d'éducation à la santé. Prochaine étape, en 2016, une étude pilote avec des bracelets connectés, menée à Lifou. Elle devrait permettre de récolter des données précises sur l'activité physique des jeunes. La rencontre de cette semaine devait examiner les possibilités d'exporter ce projet. Parmi les participants, Walter Vermeulen, directeur exécutif du Mataileoo Environment Trust, une ONG samoane. Rappelant que les adultes samoans sont à 50 % obèses, tandis que 30 % souffrent de diabète et 20 % d'hypertension, il est venu pour « comparer » les situations et les initiatives. « Et surtout maintenant pour soutenir l'étude pilote qui va avoir lieu à Lifou, que l'on pourra éventuellement exporter aux Samoa ». Du côté du Vanuatu, ces problèmes de santé sont plus récents que dans d'autres nations du Pacifique.

LA SITUATION ÉVOLUE TRÈS VITE
« Ils surviennent surtout dans les villes, à Port-Vila et à Luganville, où la consommation et les activités changent. Mais même dans les îles plus petites, les nouvelles technologies changent les choses. Il y a deux-trois ans, les jeunes s'occupaient à la chasse, à la pêche... Maintenant, ils passent beaucoup de temps à chatter. Avec la compétition à laquelle se livrent les opérateurs mobiles, c'est très peu cher », explique Bergmans lati, proviseur adjoint du lycée Bougainville à Port-Vila et par ailleurs doctorant en anthropologie. En récupérant des données, l'idée est de mesurer les activités physiques, d'informer la population et de prévenir des dangers, ce dont le pays voisin a besoin car la situation évolue très vite. Parmi les experts, aux côtés des chercheurs et des institutionnels, Gary Morgan, du MPT Innovation Group, une société australienne de consultants, était là pour apporter son appui très concret et son expérience en matière de suivi à distance des patients atteints de maladies chroniques. Le but : aider à « obtenir les financements, fixer la méthodologie et les directives ». Des étapes bien concrètes indispensables pour voir ces journées d'étude suivies d'effets.

Julia Trinson
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* Maladies liées au surpoids comme le diabète, l'hypertension, les maladies cardiaques...

Nouméa, le 8 décembre. Les participants aux journées d'étude étaient rassemblés à l'université de la Nouvelle-Calédonie depuis la veille et s'apprétaient à livrer leurs conclusions.

Monitoring NCDs mortality in Pacific Island States

Grant Team: Richard Taylor (project leader), School of Public Health and Community Medicine (SPHCM), University of New South Wales (UNSW) (Australia); INSERM. IPLESP, UPMC, EPAR (France) ; Ministry of Health, Government of Fiji (Fiji); Univ. of New Caledonia, Noumea (New Caledonia); Secretariat of the Pacific Community (Region.)

Summary

Many Pacific Island states are affected by morbidity (illness) and excess premature adult mortality with plateaux in life expectancy from NCD, including cardiovascular disease (CVD), diabetes, and cancer. An important surveillance measures is trends in level and cause of mortality from NCD. The project involved networking of contacts from Fiji, Tonga, Samoa, Vanuatu, New Caledonia, the Pacific Community (SPC), UNSW (Sydney), France, and UK; with 2 multi-lateral meetings in Sydney and Noumea, and bi-lateral networking between UNSW and Fiji, Samoa and Tonga, involving intensive data analysis. Findings included incomplete enumeration of deaths in some states, and irregularities in placement (infrequent use of Part II) and sequencing of cause of death recording on death certificates which affects selection of underlying cause of death. Major cause of death categories were CVD, followed by diabetes and cancer. IRIS software was used to re-allocate categories of diabetes and hypertension as risk factors to Part II of the death certificate, and re-select underlying cause of death; this produces higher proportional mortality from CVD and lower proportional mortality from diabetes. Spreadsheets were programmed for calculation (with 95% CIs) of age-standardised total mortality, probability of dying, and life tables; and cause-specific proportional and age-standardised mortality.

<https://sphcm.med.unsw.edu.au/centres-units/international-ncd-researchgroup/downloads>

Background

Many Pacific Island states are affected by morbidity (illness) and excess premature adult mortality with plateaux in life expectancy (demographic effects) from NCD, including heart disease and stroke, diabetes, cancer, and chronic lung disease, which are due to changes in diet and nutrition (increase in intake of animal fat, salt, and energy), tobacco and alcohol consumption, and less physical activity.

These conditions are preventable through population health promotion to modify behaviours, and alteration of cost and availability of unhealthy products; and modifiable by individual health service interventions, including medications, for those affected.

NCD surveillance measures the magnitude and distribution of health effects of NCD, and trends over time provide evidence of effectiveness of interventions. The most important population measures are: (1) Repeated population sample surveys which assess NCD and risk factors; and (2) Trends in level and cause of mortality from NCD from reported deaths.

Project objectives

1. Identify and alleviate difficulties in Pacific Island states in monitoring trends in cause of premature death from NCD by analysis of current difficulties in certification, coding, tabulation, and analysis.
2. Evaluate innovative tools and analyses as applied to available incomplete, disrupted and dislocated total mortality and cause of death data affected by considerable selection and measurement biases.
3. Pilot innovative analyses using IRIS software for semi-automated coding and selection of underlying cause of death to produce more accurate and usable NCD cause of death trends which can be used in the short and medium term to inform public health and health promotion policy.

Networking

The project involves networking between Ministry of Health (MoH) contacts in Fiji, Tonga, Samoa and Vanuatu, with university and health service contacts in New Caledonia (NC), the Pacific Community (SPC), and UNSW SPHCM, in Sydney. The networking consists of bi-lateral international activities between SPHCM UNSW and individual Pacific countries/territories, with contacts in France and the United Kingdom; and two multi-lateral international meetings in Sydney and Nouméa in late 2015.

Multilateral international meetings

Meetings were held to review existing situations in Pacific states with respect to NCD cause of death mortality analyses at:

1. School of Public Health and Community Medicine, UNSW, Sydney, Australia. 24 November 2015. Contacts present: Fiji Ministry of Health (MoH), Samoa MoH, Tonga MoH, SPHCM UNSW (4). Total 7
2. Institute de Recherche pour Développement (IRD), Nouméa, Nouvelle Calédonie. 3 December 2015. Contacts present were: Nouvelle Calédonie -L'Université de la Nouvelle Calédonie (UNC), La Direction des Affaires Sanitaire et Social (DASS), Centre Hospitalier Territorial (CHT) (2), IRD; Vanuatu MoH; SPHCM UNSW 2; SPC 2. Total 10 participants.

Bi-lateral international networking

Intensive cause of death analyses on de-identified death certificate data (containing all causes of death on the certificate) were undertaken on de-identified data provided confidentially by countries.

Fiji: Analysis of 25,116 deaths 2007-2010 (complete) containing listed causes of death (coded) in sequence in Part I and Part II of death certificate to produce underlying cause of death (multiple cause analysis)

Samoa: Analysis of 2,666 death certificates (text) and 673 deaths in Apia hospital (coded) from 2011-13 using available incomplete samples of deaths.

Tonga: Analysis of cause of death 2,500 deaths from 2010-14 after de-duplication; to be extended to 2000.

Complete network

The complete network consists of the following:

Fiji (Suva): MoH Health Information Unit, and Advisor on NCD Control. Fiji National University, College of Medicine, Nursing and Health Sciences

Samoa MoH. Tonga MoH. Vanuatu MoH. New Caledonia (Noumea): UNC, DASS, CHT

France (Paris): Institut national de la santé et de la recherche médicale (INSERM) / l'université Pierre et Marie Curie (UPMC)

United Kingdom (London): London School of Tropical Medicine and Hygiene (LSHTM).

Australia (Sydney): SPHCM, UNSW

Findings and deliverables

Evaluation of successes/challenges of **pilot analysis of NCD cause of death data** from 3 Pacific Island countries: Fiji, Samoa, Tonga. Investigation of the cause of death data provided revealed several issues related to quality and completeness.

Completeness of death registration

Whereas enumeration of deaths and cause of death data were close to complete in Fiji and Tonga, death registration is known to be incomplete in Samoa. In Tonga, deaths are registered at several sites; aggregation then de-duplication is required prior to analysis.

Cause of death coding

In some instances no causes of death were available, even though the death had been registered. In other instances, only one cause of death was recorded on the death certificate thus precluding development of any plausible sequence and resulting in the sole condition being designated as the underlying cause of death. Where text on cause of death was obtained from death certificates, considerable manual pre-processing was required to interpret abbreviations and misspelling, and to format the words in text into a form which could be read by IRIS for ICD10 coding. Where manually ICD10 coded cause of death conditions were supplied, sometimes with text derived from the ICD code, it was not possible to evaluate the veracity of the ICD10 coding. It was evident from examination of small samples of some death certificates that there were instances in which the electronic record differed from the physical death certificate by omission of some causes.

Selection of underlying cause of death: Part II of the death certificate (contributory causes) was frequently ($\approx 95\%$) blank in the electronic material provided, which meant that all conditions mentioned in Part I would be included in the sequence of conditions leading directly to death, and thus could become the underlying cause of death. It was evident from examination of small samples of some death certificates that there were instances in which the electronic record differed from the physical death certificate by re-arrangement of the sequence of causes in Part I. In some instances IRIS was unable to select the underlying cause of death because of the extent of the implausibility of the sequence of causes of death presented, and these instances required manual intervention.

ICD coding and selection of underlying cause of death using IRIS

Data from Fiji and Tonga were manually coded locally using ICD10 for each cause on the death certificate. For Samoa data, following extensive text editing, IRIS semi-automated coding software was used to assign an ICD code from the text of each cause of death on the death certificate. IRIS semi-automated coding software was then employed to select the underlying cause of death according to ICD10 logic from the coded causes of death from the death certificate.

Proportional mortality by cause

The major cause of death categories were cardiovascular disease, followed by diabetes and cancer. In one of the jurisdictions unknown or ill-defined causes of death were significant ($\approx 15\%$), whereas in other jurisdictions this category was $<5\%$. The proportion of deaths ascribed to diabetes as the underlying cause of death appeared excessive in comparison with other countries, and compared to previous mortality data coded under ICD9, and further investigation of the cause of death patterns was undertaken.

Multiple cause of death sensitivity analysis

A multiple cause of death sensitivity analysis was undertaken following re-allocation of certain causes of death from Part I (conditions leading directly to death) of the death certificate to Part II (other significant conditions contributing to death but not leading directly to it), then re-selection of the underlying cause using IRIS semi-automated coding software. It was noted that in several Pacific countries Part II of the death certificate is infrequently used (5% or less).

Re-allocation of cause of death, and re-selection of underlying cause of death using IRIS software, is an innovative use of IRIS. Multiple cause of death sensitivity analyses have hitherto been infrequent since manual re-arrangement (or exclusion) of particular causes of death, requires considerable person-months by trained coders. The conditions relocated were categories of diabetes and hypertension given as causes of death, with potentially lethal diabetes or hypertension (with specified complications according to ICD10), or these conditions combined with chronic renal disease or failure, retained in Part I of the certificate, and the remainder moved to Part II as contributory causes.

The results of these multiple cause of death sensitivity analyses produce a lower proportional mortality from diabetes (and hypertension) than obtained by selection of underlying cause of death (according to ICD10) from the data as presented, with a commensurate increase in the proportional mortality from cardiovascular disease, for which diabetes and hypertension are risk factors, along with tobacco smoking and elevated blood cholesterol (from saturated fat intake).

Programmed spreadsheets for analysis of mortality data

Spreadsheets were produced to undertake: age-standardised total mortality, probability of dying (over age intervals) and life tables from tabulated total deaths and populations (with 95% confidence intervals); and Cause specific proportional mortality and age-standardised mortality from tabulated cause specific deaths and populations (with 95% confidence

intervals). These spreadsheets are extensively used in training courses and in Pacific states for preparation of reports. <https://sphcm.med.unsw.edu.au/centres-units/international-ncd-research-group/downloads>

IRIS semi-automated coding

IRS was used to code of causes of death from text from death certificates, and semi-automated selection of underlying cause of death from coded causes of death. These analyses were undertaken on cause of death data from Fiji, Samoa and Tonga with the development of algorithms for alternative scenarios for selection of underlying cause of death, in a multiple cause of death analysis.

Geospatial Information for Assessing Environmental Livelihood Security in the South Pacific

Grant Team: Dr Eleanor Bruce, University of Sydney (Australia); Dr Floris van Ogtrop, USyd; Dr Elosie Biggs, University of Southampton; Dr Heather Price, Dr Nathan Wales, Dr Eberhard Weber, University of the South Pacific; University of Stirling; Prof Andreas Neef, University of Auckland; Dr Bryan Boruff, University of Western Australia

Summary

Susceptibility to the realities of climate variability and extremes is already being felt by subsistence and natural resource-dependent coastal communities of the South Pacific. Sea-level rise, saltwater intrusion, increased severity of tropical cyclones, rising temperatures and changes in spatiotemporal patterns of precipitation are resulting in adverse system dynamics that place these communities in a cycle of vulnerability. The urgency and importance of locally relevant solutions to leverage opportunities presented by emerging innovative technologies is clear.

This project reviewed the application of the ELS concept to utilise geospatial information for assessing water-energy-food security to provide a platform for enabling locally-driven and climate-compatible solutions. Development of resilience-building approaches that are informed and responsive to the key interdependencies between human development and environmental resource consumption require approaches that explicitly incorporate environmental livelihood security¹. New opportunities presented by geospatial technologies, such as satellite and airborne Earth observation and crowd-sourced mapping (VGI) were reviewed. An important project outcome was the identification of potential remotely sensed indicators for assessing progress towards environmental livelihood security. These were based on key issues identified by researchers and local stakeholders using a case study in the Ba catchment, Viti Levu, Fiji. A workshop held 5-7th November 2015 evaluated methods for dissemination and sharing of ELS and geospatial knowledge.

Description of context

The project examined the application of a new framework for assessing environmental livelihood security in coastal environments using remotely sensed data. This was the first time the ELS framework had been applied to a SIDS case study. CubeSat technologies are emerging as a space industry standard design for low-cost earth observation research. In June 2016 the University of Sydney was involved in satellite testing in preparation for an International Space Station launch later this year <http://sydney.edu.au/news-opinion/news/2016/06/17/satellite-testing-takes-off.html>. The current PACE-Net funded project led to discussions and research proposals for investigating the role of CubeSat technology for earth observation and monitoring in coastal environments.

¹Biggs EM, Bruce E, Boruff B, Duncan JMA, Duce S, Haworth BJ, Horsley J, Curnow J, Neef A, McNeill K, Pauli N, Van Ogtrop F, Imanari Y, (2015). Sustainable development and the water–energy–food nexus: A perspective on livelihoods. *Environmental Science & Policy* 54:389-397

Project objectives/scientific question

What are the key considerations in developing reliable remotely sensed indicators of progress towards ELS be developed?

Can the ELS framework be used to identify methods for monitoring water-food-energy linkages using geospatial information?

Project schedule

1 Oct – 15 2015: Funding received, preliminary review of relevant literature; announce workshop call and invite participants.

16 – 30 Oct 2015: Workshop preparation and field schedule planning, submit internal funding proposal (Sydney Compact)

Nov 2015: Workshop on “The role of geospatial and Earth observation technologies for monitoring environmental livelihood security in the South Pacific”

Dec 2015-Feb 2016: Collate workshop findings and reports, fieldwork summaries

March-May 2016: Finalise Frontiers in Environmental Science/Sociology submission and PNP report

June 2016: Applications for further funding

Cooperation

Building regional research networks was a key outcome of this project and geographic accessibility in the Oceania region was critical to this objective. For this reason participation of the Australian and New Zealand partners based within the region, with existing South Pacific collaborative partnerships, had immediate strategic benefit for EU-Pacific cooperation.

Main results

- Preliminary geospatial-based indicators for monitoring progress towards environmental livelihood security
- Broad-scale remotely sensed measures and aggregated socio-economic data indicators need to be informed by contextual information drawn from household and community level interviews and surveys.
- In-country workshop engaged local researchers and worked towards geospatial methods for monitoring environmental livelihood security. Regional stakeholder meetings identified priority climate compatible development research agendas.
- Specialised consortium of inter-disciplinary academics and regional partners who are able to provide expertise and respond to future funding calls for the South Pacific region.
- Preparation of an open access Frontiers in Environmental Science/ Sociology Research Topic.

Potential impact

- Assessment of progress towards environmental livelihood security in natural resource-dependant coastal communities using geospatial methods will assist in identifying opportunities for supporting socio-ecological resilience and advancing the global development agenda and UN SDGs.

- Recommendations for uptake and utilisation of EU Earth Observation products (e.g. *Sentinel-2*) for monitoring environmental livelihood sustainability in South Pacific coastal environments will inform product development.

Achievements

Research and project results

The nexus of water-energy-food security is integral for ensuring climate compatible development, but resilience within vulnerable and marginalized communities can only be achieved through the explicit incorporation of sustainable livelihoods within these nexus relationships. Environmental livelihood security (ELS) – a concept which seeks to balance natural resource supply and human demand on the environment to promote sustainability – is a critical but poorly addressed driver to climate compatible development. Increasing our understanding of nexus linkages (water, energy, food and livelihood securities) will support future sustainable solutions for ensuring livelihood resilience.

Using the ELS framework and water-energy-food linkages, indicators measurable from earth observation data were identified. Geospatial metrics, remote sensing platforms and other aggregated geospatial data source (census, socio-economic surveys, CPUE) requirements for quantifying linkages between nexus components were assessed (Figure 1). Limitations associated with remotely sensed indicator metrics were determined and used to establish recommendations for application of EU Earth Observation products and CubeSat instrumentation and platform R&D (Sydney SpaceNet). An important workshop finding was that participatory research, field based methods grounded in sociological theory and contextual information on environmental livelihoods is fundamental in understanding the socio-ecological processes underlying patterns of landscape change observed in remotely-sensed indicators. Geospatial datasets and remote sensing provides broad geographic reach and long-term regional and global coverage but data inconsistency, data availability issues in remote Small Island Developing States (SIDS) and uncertainty in continuity of observation present challenges.

Deviations compared to planned proposal

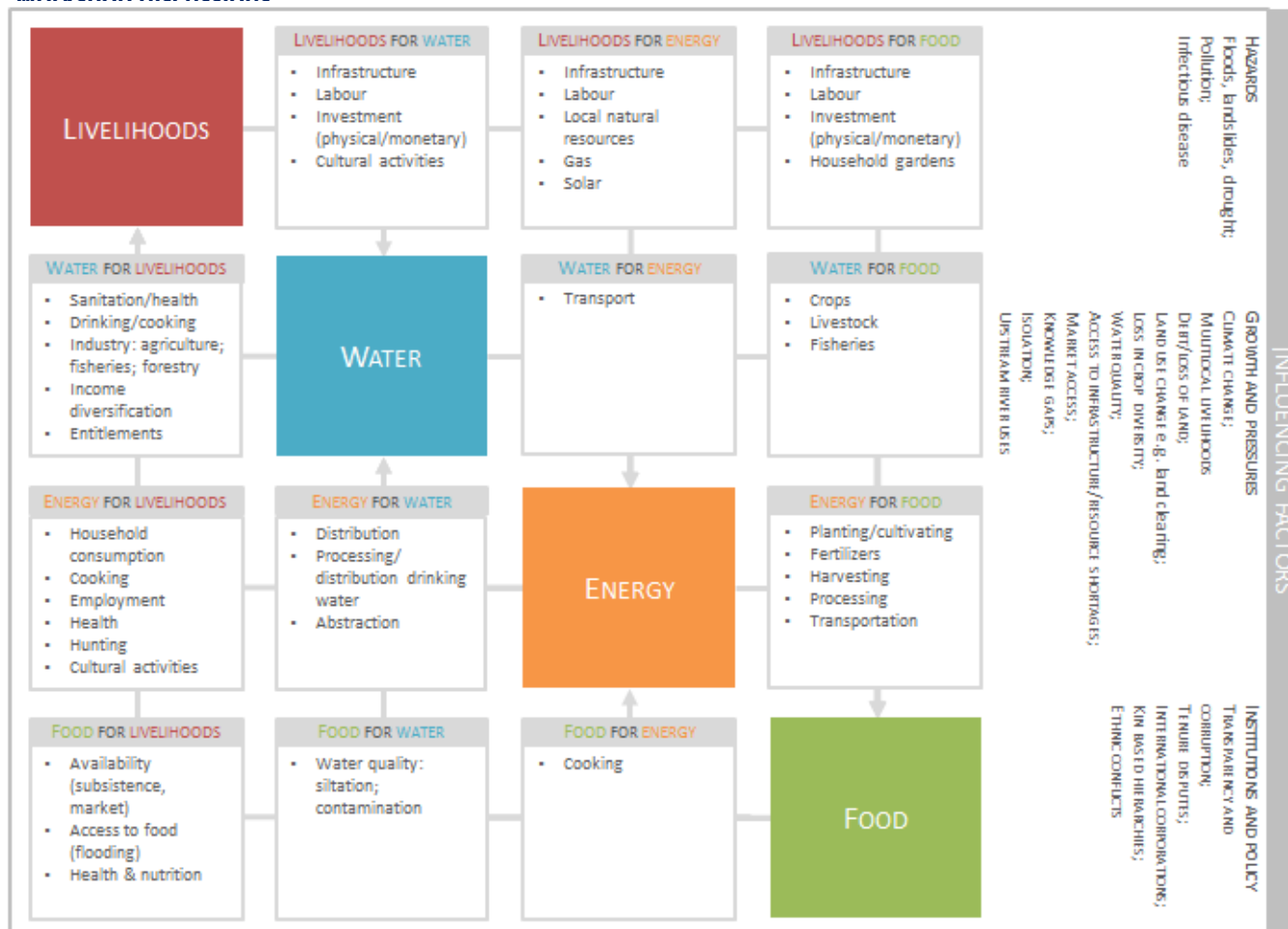
During workshop discussions it was decided, based on feedback from regional partners, that an open access *Frontiers in Environmental Science and Sociology* would encourage broader researcher engagement in WEF-nexus debates and present opportunities for approaches to be transferred to other case study areas. For this reason project efforts were redirected from preparing a technical report to a *Frontiers Research Topic*. The *Frontiers* open access publication model allows for cross-listing of research topics in multiple subject journals (including *Environmental Science and Sociology*) and specialty sections which will progress this inter-disciplinary project.

Plan for use

Dissemination of infographics through partner organisations

(http://www.iwmi.cgiar.org/Publications/Other/PDF/els_iwmi_part3_infographic.pdf)

Figure Erreur ! Signet non défini.. ELS Framework indicators developed by participants during workshop discussions



List of performance indicators (achieved and planned)

Scientific publications in books and journals

Planned publications

Bruce, E., Biggs, E, Boruff, B and Neef, A., The Water-Food-Energy Nexus and Sustainable Livelihoods, *Frontiers in Environmental Science / Sociology Research Topic Proposal* (prepared for submission), OPEN ACCESS

Boruff, B. Bruce, E., Neef, A., Biggs, E., van Ogtrop, F., Horsley, J.,McNeill, K., Pauli, N. Price, H.,(in prep.), Application of the ‘Environmental Livelihood Security’ Framework: Three case studies in vulnerable regions of Australia, Cambodia and Fiji.OPEN ACCESS

Bruce, E., van Ogtrop, F., Biggs, E., Boruff, B. et al., (in prep), The role of spatial modelling and remote sensing for assessing environmental livelihood security in coastal environmentsOPEN ACCESS

Presentations at conferences

Eleanor Bruce (2016), Geographical citizen science and VGI for marine and coastal environments. *EO Open Science 2.OESA*, 13/10/2015, European Space Agency, Frascati, Italy

Eloise Biggs (2015), Sustainable Development and the Water-Energy-Food Nexus A perspective on livelihoods, *Future Earth WEF Nexus Workshop*, 23-25 November 2015, Karlsruhe, Germany

Heather Price (2015), The Role of Geospatial Information for Assessing Environmental Livelihood Security in the South Pacific, Sustainable Development and the Water-Energy-Food Nexus: A perspective on livelihoods, *Future Earth WEF Nexus Workshop*, 23-25 November 2015, Karlsruhe, Germany

Bryan Boruff (2016), Application of the 'Environmental Livelihood Security' Framework: Three case studies in vulnerable regions of Australia, Cambodia and Fiji, 29 March-2 April 2016, *American Association of Geographers Annual Meeting*, San Francisco, US

Supervision of theses

Student: Jamie Simpson, (2016). *Examining socio-ecological resilience in flood prone areas using remote sensing*, Honour Thesis, School of Geosciences, University of Sydney (Supervisor: Eleanor Bruce)

Organised workshops

Eleanor Bruce, University of Sydney (2015), *The role of geospatial and Earth observation technologies for monitoring environmental livelihood security in the South Pacific*, 6th November 2016, Earth Science and Environment Conference Room, University of the South Pacific, Laucala Campus, Fiji.

Scientific meetings with cooperation partners

Ba Provincial Council, 3/11/2015, Lautoka, Viti Levu, Fiji

Wolf Forstreuter, 5/11/2015, Secretariat of the Pacific Community Geoscience Division (SPC-SOPAC)

Jayne Curnow, Chris Barlow, 30/05/2016 and 20/06/2016, Australian Centre for International Agricultural Research (ACIAR), Canberra, Australia

Taaniela Kula, 4/05/2016, Ministry of Lands, Survey and Natural Resources, Tonga (email communication regarding collaboration on further grant proposals)

Field work phases

Project researchers visited the Ba catchment from 2 - 4 November 2015. This field visit was held in conjunction with research activities related to the APN funded project titled Climate Change and Adaptation in Post-Disaster Processes in Fiji and Cambodia (CAF2015-RR10_NMY-Neef) and time was spent with three communities in Votua, Nawaqarua and Navala to inform village leaders and provincial authorities of the research projects. This provided researchers the opportunity to observe environmental livelihood security issues, landscape change and ground control features for registration and verification of satellite imagery data.



Figure 2. Workshop focus group discussions, seminars and field visits

Others (e.g. blogs, podcasts)

Knowledge sharing and project awareness was promoted through active Twitter feeds and media coverage.

Fiji One New Bulletin 071115

<https://www.youtube.com/watch?v=ZcDOtoAUtRM&feature=youtu.be&t=10m45s>

 Twitter #ELSFiji

Evaluation

Benefits (e.g. environmental, economic relevance)

The project contributes to two PACE-Net Plus societal challenges: (1) food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bioeconomy; (2) climate action, resource efficiency and raw materials. Through geospatial assessment of water-energy-food security for livelihoods in the South Pacific, future funded projects will capitalise on EU Earth observation research innovation and geospatial technologies, leading to valuable product applications. Enquiry into nexus-thinking for promoting ELS within the South Pacific has direct applicability to climate action for ensuring environmental integrity, resilience and sustainability.

Potential for follow-up funding (e.g. submission of proposals for third-party funding)

Research outcomes, regional stakeholder networks and field experience provided from this project has allowed the research consortium to identify priority research agendas that will strengthen future funding bids.

Proposals for third-party funding:

- USyd Compact Funding application (submitted)
- ACIAR Climate smart landscapes for sustainable agriculture in the South Pacific (planned)
- ARC Linkage (contributing partner organisations required)

Research attempts without outcome

Honours student project: Examining socio-ecological resilience in flood prone areas using remote sensing (Jamie Simpson).

Evaluating the Sustainability of Deepwater Snapper Fisheries in the Pacific Region

Grant Team: Dr Ashley Williams (project leader) Secretariat of the Pacific Community, Simon Nicol, SPC; Christophe Menkes & Anne Lorrain, Institut de Recherche pour le Développement (IRD); Stuart Hanchet & Alistair Dunn, National Institute of Water and Atmospheric Research (NIWA); Nicholas Hill & Michael Kingsford, James Cook University (JCU)

Summary

Sustainable management of fisheries must occur to ensure food security within Pacific nations. However, resource limitations have hindered progress in managing deepwater fisheries, which represent a significant commodity, leaving them susceptible to overexploitation. The aim of this project was to assess the sustainability of Tonga's deepwater snapper fishery and use lessons learnt from this case study to outline recommendations for the broader Pacific region. Three data-poor assessment techniques were applied to Tonga's fishery and required monitoring programs and examples of possible management controls were outlined. Tonga's fishery was assessed as overfished, but declining catch rates in recent years has allowed the fishery to begin recovery, suggesting that current catch rates are sustainable. These outcomes have been presented to Tonga's fisheries department and received well by stakeholders. Outcomes have led to a review being undertaken of Tonga's current management plan. A manuscript is currently underway applying these findings to a broader Pacific region context, with collaborations underway with Western Australia, Papua New Guinea, Vanuatu and the Solomon Islands.

Background

Deepwater fisheries are becoming increasingly important for food security globally as populations expand and alternative fisheries decline. In tropical and sub-tropical regions, snappers are important components of deepwater demersal fisheries and provide an important source of income and protein to Pacific Islanders who are highly dependent on fish for food security. However, the slow life history characteristics of deepwater snappers make them particularly vulnerable to exploitation with evidence that some stocks are overfished.

The management of deepwater snapper fisheries is becoming an increasing priority across the South Pacific region with similar issues facing Fiji, French Polynesia, New Caledonia, Niue, PNG, Samoa, Solomon Islands, Tonga, Vanuatu and Wallis and Futuna. The importance of developing improved stock assessments has been stressed by senior fisheries staff at several recent meetings. However, stock assessments of deepwater snapper in the South Pacific have been limited to simple production models conducted more than 25 years ago. As such, there is substantial uncertainty in the sustainability and status of contemporary deepwater snapper fisheries in the region. The relatively recent development of novel approaches for assessing data-poor fisheries provides an opportunity to evaluate the applicability of these approaches for deepwater snapper.

Project objectives

The aim of this project was to apply some of these novel techniques to the deepwater snapper fisheries in the Pacific region and to assess the current sustainability and viability of these fisheries by establishing appropriate population indicators to inform management decisions.

Project schedule

The main objective of this project was to evaluate the applicability of data-poor fisheries assessment methods for deepwater snapper fisheries in the Pacific region. To achieve this, the project compared outputs from data-poor methods with traditional surplus production and per-recruit models.

The project involved the following activities:

- a. Collate and prepare fisheries catch and effort data from deepwater snapper fisheries
- b. Collate and prepare port sampling species-specific length data from deepwater snapper fisheries
- c. Analyse existing biological data to provide estimates of population parameters required to develop per-recruit models
- d. Develop surplus production models to provide estimates of Maximum Sustainable Yield (MSY) required to achieve biological reference points
- e. Develop and evaluate appropriate indicators for assessments of deepwater snapper stocks

Cooperation

The success of this project would not have been possible without the cooperation and collaboration among the project partners and end-users of the results from this project. Efforts were made to ensure ongoing communication and cooperation with Pacific Island fisheries managers during the entire period of the project, and cooperation continues post-project to ensure uptake of project results is maximised.

Main results

A traditional biomass dynamic model and two recently developed data-poor assessment techniques were assessed for their applicability for resource-limited fisheries within the Pacific region. Application of these data-poor assessment techniques was successfully undertaken for Tonga's resource-limited deepwater snapper fishery. Tonga's fishery was assessed as overfished, but declining catch rates in recent years has allowed the fishery to begin recovery, suggesting that current catch rates are sustainable. The project outlined appropriate monitoring programs, assessment techniques and examples of possible harvest control rules for resource-poor fisheries.

Potential impact

By considering inherent resource limitations within Pacific nations, the project was able to provide long-term, viable options for sustainable fisheries management. Based on these results, Tongan fisheries are currently undertaking a review of their deepwater fishery to apply recommendations as a result of this research. At a Pacific-wide level, this project has outlined viable data-poor assessment techniques and monitoring programs that can be implemented to monitor coastal and deepwater fisheries, improving management capacity.

Achievements

Research and project results

This project achieved its desired outcomes. Improvement in the management approaches available to deepwater snapper fisheries in the Pacific has been achieved. Numerous viable assessment techniques and required monitoring programs within a broader harvest strategy framework were outlined. Example indicators were outlined for Tonga's fishery, but these will be case specific depending on fishery characteristics and resources available for each nation. Partnerships were formed with Tonga's fisheries department along with interest expressed from Papua New Guinea, Solomon Islands, Kiribati and Vanuatu; all who wish to develop their deepwater fisheries. A technical fact sheet and subsequent newsletter article has been produced to disseminate this information throughout Pacific nations and broader audiences. A manuscript outlining these results and their application in a broader Pacific context is currently underway.

Plan for use (e.g. knowledge exchange, management plans)

Since the completion of this project, Tonga has advanced the development of their Deepwater Snapper Fisheries Management Plan, and Vanuatu has finalised their first ever Deepwater Snapper Fisheries Management Plan. A working group has been established, involving scientists and fisheries managers from Vanuatu, Samoa, Tonga, Western Australia and Hawaii, with the aim of advancing the assessment and management of deepwater snapper fisheries resources in the Indo-Pacific region. A meeting of this working group is planned for July 2016. Furthermore, the outcomes from this project are planned to be presented at the Australian Society for Fish Biology Conference in September 2016.

List of performance indicators

a. Scientific publications in books and journals

Hill, N. J., Williams, A. J., Peatman, T., Nicol, S. J., Wakefield, C. B., Newman, S. J., & Halafih, T. (In prep). Development of harvest strategies for resource-limited fisheries. To be submitted to *Marine Policy*.

b. Other publications

Hill, N.J., Williams, A. J., Peatman, T., Nicol, S. J. & Halafih, T. (2016). Development of a harvest strategy for resource-limited deepwater snapper fisheries. Technical Report, Secretariat of the Pacific Community, Noumea. DOI: 10.13140/RG.2.1.2861.5447. 'OPEN ACCESS'.

Hill, N.J., Williams, A.J., Peatman, T., Nicol, S. J. & Halafih, T. (2016). Application of a harvest strategy to a resource-limited deepwater snapper fishery. *SPC Fisheries Newsletter*, Vol. 149, 24-30. 'OPENACCESS'.

c. Presentations at conferences

Nicholas Hill (2016). Application of a harvest strategy to a resource-poor fishery – Tonga's deepwater snapper fishery. Australian Society of Fish Biology Conference, 5 – 8th September 2016, Hobart, Australia.

d. Organised workshops

Department of Fisheries, Western Australia. Third Deep-water Snapper and Grouper Life History Workshop. 18 – 22 July 2016. Western Australian Fisheries and Marine Research Laboratories, Hillary's Marina, Perth, Western Australia.

Department of Fisheries, Tonga. Deep-water Snapper fishery assessment and management framework workshop. 30 – 31 August 2016. Tongatapu, Tonga.

Evaluation

a. Benefits

The ability for Pacific nations to autonomously manage their fisheries resources is an important step in ensuring sustainable use. Outlining applicable monitoring programs and assessment techniques within a harvest strategy framework is an important component to achieving this. By outlining necessary considerations and steps that must be undertaken by managing in the process of developing a fisheries management plan, a more sustainable framework can result. There is substantial potential for this research to continue and progress. Few efforts have been made in improving the management capacity of resource-limited fisheries. With a recent focus on developing data-poor fisheries, there is a natural continuum towards improving and applying these techniques for a resource-poor context.

b. Potential for follow-up funding (e.g. submission of proposals for third-party funding)

None at this stage.

Pacific Food Matters: traditional knowledge solutions with ecological science

Grant Team: Dr. Jessica Hutchings (Principle investigator), New Zealand Council for Educational Research (NZCER). **Partners:** Karen Mapusua & Stephen Hazelman: Pacific Organic and Ethical Trade Community, Fiji. Jo Smith: Victoria University, Wellington. Francois Japoit: -Institut Agronomique de Nouvelle-Calédonie-IAC. Gesche Krause: AWI, Germany. Takena Redfern: Min. of Environment, Lands and Agricultural Development: Kiribati. Valerie Kagy: IAC. Valerie Tuia: Centre for Pacific Crops and Trees, Suva.

Summary

How can the convergence of traditional knowledge and ecological science offer solutions to local and global food security? Food security includes access to sufficient, safe and nutritious food to maintain active and healthy lifestyles.

Food security, within a traditional knowledge framework connects with other dimensions of social life best expressed in the links between tangata (people) whenua (land) and moana (sea). Accelerated climate change coupled with globalised food systems impacts on Pacific Island food security and traditional food knowledge systems and practices. *Pacific Food Matters* creates opportunities for furthering multi-regional science, technology and innovation (STI) cooperation between the South Pacific island nations, NZ and the EU. Traditional knowledge and farming practices are closely aligned with organic food production. In the Pacific, the Oceanian standard Bio Pasifika, provides a verification pathway to enhance the economic and social value of organics from the Pacific.

The project engaged experts and communities involved in these initiatives and produces new and innovative collaborations between traditional communities, experts, researchers and scientists that will build solutions to local and global food security issues.

Project context (research outcome)

To innovate and improve organic food security for local communities, farmers and families by sharing, generating and applying new knowledge drawn from across diverse traditional knowledge, practices, social and ecological sciences.²

Project objectives

Overarching Research Thematic

Pacific Food Matters takes a complex systems approach to building and transferring diverse knowledge that will enhance organic food security between people, land and sea. These exchanges include organic and traditional, ecological, social and scientific discourses. A central focus is to produce a range of outputs to contribute across varying levels of the organic food security network from communities, farmers and families to agencies, scientists, students, educators and researchers. These outputs will enhance the socialisation of organic food security issues at national, regional and local levels in both political and social ways.

² By local communities, farmers and families we mean those in the Pacific Islands, the Arctic, and New Zealand.

Key Overarching Questions

- This research agenda has three key research thematic: 1) soil fertility, 2) knowledge transfer and uptake and 3) education, learning and knowledge systems. Key overarching questions are:
- What are the most effective organic and traditional practices to manage soil fertility and what innovative and relevant technologies can farmers apply to monitor and enhance their soil fertility to improve organic food security?
- What are the tools, techniques and relationships needed to enhance and innovate the transfer and sustainable uptake of diverse knowledge that promote organic food security?
- In what ways can informal (tribal and community meetings and gatherings, workshops, on-farm exchanges etc.) and formal education strategies (curriculum design, the development of learning pathways from primary through to tertiary) contribute to the development of new knowledge systems, skills and abilities required to address the complexities of organic food security?

Project schedule

Teleconference with all project partners in November 2015.

Two 3 day meetings with all project partners held in Suva, Fiji on 1-3 February and 29-3 March 2016. Purpose of the meeting was to build the shared research agenda and to identify future funding streams to support this research work. Project partners had research and scientific tasks to undertake in-between meetings.

Cooperation

Our collaboration is multiregional involving lead partners based in New Zealand, Fiji, Kiribati, New Caledonia, and Germany and including affiliated regional networks across the Pacific.³ The lead partners are New Zealand Council for Educational Research, Pacific Organic Ethical Trade Community (POETCom), Victoria University of Wellington (VUW), the Alfred-Wegener Institut (AWI), Pacific Community Centre for Pacific Crops and Trees (CePaCT), Institut Agronomique de Nouvelle-Calédonie (IAC), Chambre d'Agriculture and, the Ministry of Environment, Lands and Agricultural Development, Kiribati.

Main results

Pacific Food Matters Research Agenda

The outcome of the Pacific Food Matters is a multidisciplinary research agenda developed in 2015-2016 and supported by PACE-NET Plus seeding money. The attached summary research agenda represents the shared thinking of the Pacific Food Matters project members as well as the shared aspiration to pursue a 10-year research agenda that will connect to practices and strategies on the ground to enhance organic food security both locally, and globally. The next phase of this project, post PACE-NET Plus funding, is to pursue funding opportunities to implement the research agenda.

³ These regional affiliations are connected through the networks of POETCom that include 15 Pacific countries, diverse Māori communities engaged through the networks of Te Wāhanga, NZCER and Indigenous Arctic communities engaged through the networks of AWI.

Who will use this research agenda?

The full research agenda is confidential between Pacific Food Matters partners and the funders only. The full research agenda is to be used as a guide and aid in the preparation of funding proposals under the banner of Pacific Food Matters. We expect to share the summary of this document for the purpose of profiling the Pacific Food Matters network as well as to attract future funding. A translation of the summary document will be made into French.

Potential impact

Future research and innovation between EU, Pacific and NZ.

Achievements

Research and project results

- Pacific Food Matters Research Agenda (Internal document for the project team and funder)
- Digitally designed four-page Pacific Food Matters Summary Sheet, for wide dissemination across project partners' communities.
- 12 minute video
- Pacific Food Matters on-line project page as a exchange knowledge tool

Plan for use

Pacific Food Matters Summary Sheet

List of performance indicators (planned)

- a. Hutchings, J. Smith, J. (2016) Food stories from the flax roots. Journal of Polynesian Society. Planned for 2016.
- b. Smith, J, Hutchings, J. (2016) What is the role of community media in supporting Indigenous and local research agendas. Media studies journal. Planned for 2016.
- c. Organised workshops – Two (see hereafter)

Pacific Food Matters Scientific Workshop 1: 1-3 February, Suva, Fiji. Attendees: Dr Jessica Hutchings (Project Leader), Karen Mapusua, Stephen Hazelman, POETCom, Dr Jo Smith, VUW, Francois Japoit, IAC, Valery Kagy, IAC, Takena Redfern, Kiribati, Valerie Tuia, Pacific Crop and Trees

Objective: Producing innovation and excellent science through knowledge exchange between EU, Pacific, NZ researchers, organisations and PACE-NET partners.

Outcome: A collective understanding of the current initiatives between the partners to understand the strategic research thematic and opportunities with regard to organic food security in the Pacific. Draft research thematic developed.

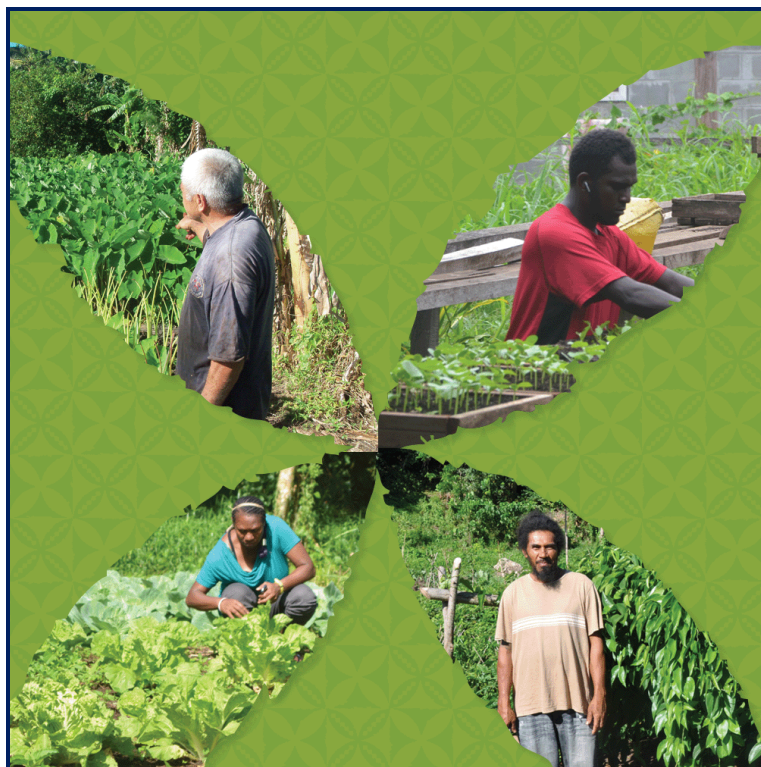
100% achieved.

Pacific Food Matters Scientific Workshop 2: 29-3 March, Suva, Fiji. Attendees: Dr Jessica Hutchings (Project Leader), Karen Mapusua, POETCom, Dr Jo Smith, VUW, Francois Japoit, IAC, Julien Droiun, IAC.

Objective: To consolidate the research thematic and identify research priorities and potential alignment research funding opportunities.

100% achieved.

- d. Others: On-line project page developed see www.jessicahutchings.org.nz/pacificfoodmatters (12 minute video from scientific meeting 1.)



Evaluation

Benefits (e.g. environmental, economic relevance)

Strong working collaboration formed across project partners, benefits for extending and building new knowledge in the spaces in-between traditional knowledge, social and ecological science. Relevance for health, environmental, economic, cultural and social outcomes.

Potential for follow-up funding

Funding scheduled developed: First application to be made to the Catalyst Fund (NZ) closes 30 July.

Pilot inventory of traditional knowledge of ciguatera fish poisoning and its treatment

Grant Team Dr. Jimaima Lako (project leader), The University of the South Pacific and Dr Ralph Mana, University of Papua New Guinea; Dr Jordi Molgo, CEA, Toxicology Lab, France; Dr Naisilisili, USP; Ms Tuqiri, Ministry of Fisheries, Fiji

Executive summary

Even though ciguatoxin is a threat to health, trade and livelihood, it appears that Fijians continue to catch, sell and eat ciguatoxic fish. There may be various reasons such as the use and value of traditional knowledge in the treatment, heavy reliance on fish for food, trade and livelihood, absence of any ciguatera regulatory framework, poor reporting and monitoring system in Fiji may have trigger the behaviour. Scientific investigation in the validation of traditional knowledge is essential to confirm the types of macroalgae responsible for providing habitat to the dinoflagellate responsible for ciguatoxin occurrence, accumulation, production and their distribution in various hotspots, seasonality, fish species and organs is warranted. This may help in the management, monitoring, reporting, treatment and drug development of ciguatera fish poisoning cases in Fiji which could then be replicated in other Pacific Island countries where ciguatoxin is prevalent.

Description of context

Ciguatera Fish Poisoning is a food security, food safety and health, economic growth and livelihood issue that is fundamental to the health, social and economic growth of individuals, families and the Pacific Island region as a whole, because they depend on fish for subsistence, export and tourist trade.

It appears that in Fiji and its neighbouring countries, there has been high incidence of ciguatera fish poisoning, however a lot of cases are not reported especially those from the rural and isolated communities and this affects the recording of data. This is evident in the inconsistencies of the data reported by the Ministry of Health and researchers' data such as Skinner *et al.*, (2011). However, it is interesting to acknowledge that incidence of ciguatera fish poisoning had been to date managed and treated through the use of traditional plants and medicine due to limited drugs available.

Project objectives/scientific question

The aim of the project was to quantify the use and value of traditional knowledge of ciguatera fish poisoning in two Pacific Island countries; Fiji and Papua New Guinea.

The objectives were to explore traditional knowledge to identify ciguatoxin fish species, iqoliqoli hot spots, seasonality, reporting mechanism and treatment of ciguatoxin in Fiji.

Project schedule

At least 4 categories of traditional knowledge related to ciguatoxin incidence and /or outbreak; i) species of fish; ii) seasonality; iii) site/location of occurrence/hot spots where the fish was caught with associated status and history of ecosystem/natural events and stress level of the site; iv) treatment with the use of herbal plant/medicine in Fiji were gathered

through various activities; survey data and report obtained from the Fiji Ministry of Fisheries, face-face interviews using the piloted questionnaires, field observation and discussions from a 2-day stakeholder workshop held in Suva from 30-31st March, 2016;

Cooperation

The project is in collaboration with both internal and external partners; the School of Education, USP; Fiji Ministry of Fisheries and Forests, World Wide for Fund Fiji Office, Japan Cooperation International Agency and the Institute of Biology and Technology Saclay in France.

Main results

The projects have identified and assessed the value of traditional knowledge related to the following;

➤ Species of ciguatoxic fish in Fiji

These include Moray eel sp, Two Sport Red Snapper, Long-face emperor, Rivulated snapper, Brown- Marbled Grouper, Pick Handle Barracuda, Leopard coral grouper, Gold spot herring, Mangrove red snapper, Black branded snapper, Russells' snapper and Long Spot Snapper. However, it interesting to note that some fish indicated above are toxic in certain reefs but not in others, as well as those species that were not poisonous in the past have become poisonous now. For example, the Mangrove red snapper (Mangrove Jack) that are poisonous in Macuata is not poisonous in Cicia reefs and the Long- face emperor known not poisonous have become poisonous in some places on Cicia. This data shows that scientific investigations is needed to validate and confirm Traditional Knowledge in areas related to the types of macroalgae primarily responsible for providing habitat to the dinoflagellate *Gambierdiscus toxicus* and its related species that are responsible for ciguatoxin occurrence, accumulation, production and their distribution in various hotspots, seasonality, fish species and organs. Perhaps the development of ciguatoxin test kits in collaboration with international organisations and institutions could also be explored.

➤ Seasonality of ciguatoxin

Ciguatoxin in Fiji appears to be seasonal for some fish in certain parts of reef while some do not. The seasonality of ciguatoxin appears to be closely associated with the *Balolo season which takes place from the months of September to December. It is noted that there is no scientific link between the Balolo season and ciguatoxin, however further investigation in this area is warranted.

➤ Sites and hotspots of occurrence

It appears that there are ciguatoxin localized reefs such as in Senimuna in Kadavu, Kabara reef in Lau, where all fish are apparently poisonous. Perhaps a further investigation on the ecosystem condition and stress related to environmental changes linking the ridge to reef exploitation activities, shipwreck, pollution, microalgae distribution, etc may be required.

➤ Traditional herbal treatment of ciguatoxin

More than six sets of effective traditional herbal medicine were identified for the treatment of ciguatoxin. Some may be effective than others in the rate at which recovery from

ciguatoxin occurred, however these have yet to be scientifically proven and tested especially the identification of the active components and the dose response level. This calls for further work by the researchers and scientists in collaboration with international partners.

Potential impact

Clear identification of ciguatoxin fish species, hot spots, seasonality which will contribute to safe management of fish consumption and the development of a standard method of reporting and monitoring of ciguatera fish poisoning incidence and the discovery of potential chemicals for the treatment of ciguatoxin through some bio-discovery/chemical analysis that lead to the development of medications.

Achievements

Research and project results

The 4 categories of traditional knowledge listed in (6) above were carried out through students project at postgraduate diploma level research in collaboration with the Fisheries department and the iTaukei (indigenous) Affairs department in preliminary stage of gathering of information using the following activities;

Literature review

A chemistry postgraduate diploma student of CH413: Natural Products Chemistry and the Ministry of Fisheries progressive ciguatera baseline survey report contributed to the collection of the literature review compilation.

Development of questionnaires

2 postgraduate diploma students of BI439: Advances in Food Science contributed to the development of the questionnaires as part of their major project under the supervision of Dr Lako and Dr Naisilisili of the University of the South Pacific.

Piloting of questionnaires and in-depth interview

Piloting of questionnaires was conducted on Cicia Island by Dr Lako and during the Ciguatera Fish Poisoning workshop conducted on the 30-31st March 2016 at the Tanoa Plaza, Suva, Fiji by the two postgraduate diploma students. The information gathered from the Cicia pilot was also presented at the Ciguatera Fish Poisoning workshop at the Tanoa Plaza. The in-depth interview is currently been conducted by Dr Naisilisili in Vanua Levu.

Preliminary identification of effective herbal plants and medicine based on the pilot questionnaires

Effective herbal plants and medicine for ciguatoxin was collected from the Cicia pilot by Dr Lako and from the ciguatera fish poisoning workshop at the Tanoa Plaza. These information were collated which helped in the identification of plants that had started to take place. These were carried out by taking pictures of the plants as confirmed by the traditional healers and the compilation of written instructions for the preparations of extracts conducted as post workshop activity.

Stakeholder Workshop

<http://www.usp.ac.fj/news/story.php?id=2064>, <http://www.fbc.com.fj/fiji/38876/ciguatera-fish-poisoning-should-be-reported>, <http://www.fbc.com.fj/fiji/38894/fish-poisoning-threat-to-economy>,

A 2-day Ciguatera Fish Poisoning Workshop was conducted on the 30-31st March at the Tanoa Plaza, Suva as part of a project entitled “Pilot Inventory of Traditional Knowledge of Ciguatera Fish Poisoning and Its Treatment in the Pacific Island Region; Fiji and PNG”, an EU PACE-NET+ seed funding project. It was organized by the School of Biological and Chemical Sciences, FSTE in collaboration with the School of Education, FALE, The University of the South Pacific; the Ministry of Fisheries and Forests, World Wide Fund for Nature Fiji Office and JICA.

The purpose of the workshop was to raise ciguatoxin awareness, and to recognize and collect relevant traditional knowledge related to ciguatera fish poisoning and its treatment.

The workshop was opened by the Minister for Fisheries and Forest; Mr Naiqamu.

A total of 22 participants representing fishermen, holders of traditional knowledge and ciguatoxin victims from Kadavu, Lau, Lomaiviti, Rewa, Lautoka, Muaivuso, Waiqanake and Maucata, as well representatives from the Food Unit of the Ministry of Health and Ministry of ITaukei Affairs attended the workshop.

Deviations compared to planned proposal

Major difficulty: The late arrival of fund to the University of the South Pacific and the slow process in accessing the vote code which resulted in our late field work and workshop. This did not give us enough time to conduct field work and workshop in both Fiji and PNG. Hence the major deviation for this project was the 100% focus in Fiji without PNG. The grant was only receipt at USP in January 2016 and researchers were able to access the fund from USP only in March 2016 after USP was able to provide a vote code. Hence, there was limited time to conduct and complete the project in both countries.

Furthermore, according to our PNG partner, 5,000 Euro was insufficient to conduct research in PNG and agreed that all seed funding to be spent in Fiji as the major pilot site, while PNG could be included in the major fund application for the H2020.

Further in-depth interviews are to be carried out by Dr Naisilisili and students in other part of Fiji such as Vanua Levu.

The ciguatoxicologist Dr Jordi is yet to be brought to Fiji for collection and sampling of traditional medicine for further verification.

Plan for use

Issues and plan of addressing them	Plan of Addressing
Base on the information gathered through traditional knowledge, there are still lots of confusion and misunderstanding between the three major types of fish poisoning; ciguatoxin,	Training and clarification of the types of fish poisoning among stakeholders particularly the Fisheries and Health Officers in order to collect reliable ciguatera fish poisoning data.

<p>histamine fish poisoning and tetrodotoxin in the various species of fish.</p>	
<p>The common species of ciguatoxic fish in all parts of Fiji are Moray eel, Two Spot Red Snapper, Pick Handle Barracuda and Lon-face Emperor, however there are some species of ciguatoxic fish that are localized in that they are poisonous in only some areas but not in others such as <i>Senimuna</i> reef in Kadavu or seasonal ciguatoxin mainly associated with the <i>Balolo</i> seasonality and the environmental changes linking the ridge to reef exploitation activities such as the Mahogany root toxin that polluted the sea. There is also a lot of unknown information on the ecosystem history and status of the sites and hot spots of ciguatoxin, the associated macro algae such as <i>Bulewa</i> (soft coral) that are thought to providing habitat to the dinoflagellate <i>Gambierdiscus toxicus</i> and its related species that are responsible for ciguatoxin occurrence, accumulation, production and their distribution in various hotspots, seasonality, fish species and organs.</p>	<p>Further mapping conducted by the Ministry of Fisheries with researchers and stakeholders to identify specific poisonous sites with scientific confirmations of the growth and distribution of macro algae and phytoplankton's responsible for the responsible for providing habitat to the dinoflagellate <i>Gambierdiscus toxicus</i> and its related species that are responsible for ciguatoxin occurrence, accumulation, production and their distribution in various hotspots, seasonality, fish species and organs.</p> <p>Researchers to accompany the Ministry of Fisheries during their baseline survey in the sampling and observations of macro algae from various <i>iqoliqoli</i> sites for further scientific investigations.</p> <p>Development of ciguatoxin test kits in collaboration with international organisations and institutions could be explored for the confirmation of the toxins in fish by fishers, retailers and consumers.</p> <p>A SRT proposal entitled "<i>Investigating ciguatera fish poisoning in Fiji water hotspots – traditional ecological knowledge and biological processes of occurrence and accumulation in seafood</i>" is in preparation for grant submission of FJ\$50,000 request.</p>
<p>Even though Ciguatoxin is a threat to health, trade and livelihood, it appears that Fijians continue to fish, sell and eat ciguatoxin fish which may due to various reasons. Perhaps their heavy reliance on fish for food, trade and livelihood coupled by the absence of any ciguatera regulatory framework in Fiji may trigger the behaviour.</p>	<p>Development of a regulatory framework related to the catch and sale of ciguatoxic fish in the market place.</p>
<p>It is also noted that given the high frequency of fish consumption in the Eastern Division due to limited options for alternative protein sources compared to the other 3 divisions as reported from the Ministry of Fisheries survey and the absence of a formal ciguatera reporting system in Fiji, the reported and identified incidence cases of ciguatera fish poisoning is underreported.</p> <p>It appears that fish poisoning cases collected by the Ministry of Health are only reported cases that</p>	<p>Development of a formal ciguatera fish poisoning incidence reporting system in order to capture reliable data for proper monitoring and management. The development of a formal reporting system could be included as part of the regulatory framework recommended above.</p> <p>In order to capture these unreported cases, it is suggested that the Ministry of Fisheries and researchers to request the ITaukei Ministry for</p>

<p>visit health centres or hospitals, which may mean that there are a lot more unreported cases especially in rural communities</p>	<p>possibility of including ciguatera fish poisoning cases in the existing reporting template used by the Turaga-ni-koro around the country. This may require trainings of the Turaga-ni-koro in the identification of ciguatoxin and the filling in of the proposed new template. The data gathered could be available every three months with the approval of the ITaukei Affairs through the Provincial Offices.</p>
<p>There has been limited written information available locally that is related to fish species and associated poisonous sites and traditional medicine treatment.</p>	<p>A booklet based on “Traditional Knowledge” to indicate species of poisonous fish, poisonous site and traditional medicine in the treatment of ciguatera fish poisoning is to be developed.</p>
<p>More than six effective traditional medicines have been identified for the treatment of ciguatoxin. Some may be stronger than others in the rate at which recovery from ciguatoxin have taken place, however these have yet to be scientifically proven and tested.</p>	<p>Further work by the researchers and scientists in collaboration with international partners to be carried out in the testing and confirmation of the active components of herbs and dose response to be carried out as the pathway to drug discovery for ciguatoxin.</p> <p>There is a proposed collaborative research on the severity of neurological symptoms of ciguatoxin related to the amount of toxin consumed with Friedrich-Alexander University Erlangen-Nurnberg, Department of Anaesthesiology, Germany</p>

List of performance indicators (achieved and planned)

- a. Scientific publications in books and journals (format: Author, A., Author, B., Author, C. (20xx). Title. Journal Volume (Issue)
- b. Other publications (*e.g.* white papers, expert opinions)
- c. Presentations at conferences (format: Presenter (20xx). Title. Conference, Date, Venue)
- d. Other presentations (*e.g.* for public audience)
- e. Supervision of theses (format: Student N.N. (20xx). Thesis title. University. xxx p. (Supervisors: N.N.))
- f. Organised workshops (Organiser: Dr Jimaima Lako (26 participants). Title: Ciguatera Stakeholder Workshop; Date: 30-31st March, 2016, Venue: Tanoa Plaza, Suva) - Achieved
- g. Scientific meetings with cooperation partners (format: Name, Date, Venue)
- h. Field work phases (Piloting of Questionnaires; Time period: Jan 19th-26th, 2016, Venue: Cicia island, Lau, Fiji (Staff Name: Dr Jimaima Lako))- Achieved
- i. Others (*e.g.* blogs, podcasts)

Evaluation

Benefits (e.g. environmental, economic relevance)

Opportunity for the development of a ciguatera regulatory framework, including the formalization of the ciguatera fish poisoning reporting system in order to capture reliable data that could be used for proper monitoring and management.

Potential for follow-up funding (e.g. submission of proposals for third-party funding)

- A proposal entitled “Investigating ciguatera fish poisoning in Fiji water hotspots – traditional ecological knowledge and biological processes of occurrence and accumulation in seafood” is in preparation for grant submission of FJ\$50,000 request through the University of the South Pacific, FIJI.
- A proposal for a collaborative research grant application of 100,000 Euros through the German Ministry for Research and Development is been planned on the severity of neurological symptoms of ciguatoxin related to the amount of toxin consumed together with Friedrich- Alexander University Erlangen-Nurnberg, Department of Anaesthesiology, Germany.
- To develop a major fund proposal for the H2020.



Improving the knowledge base for ciguatera monitoring and protection of public health and local economies in OCTs, Pacific Island Countries and Territories, Australia and New Zealand

Grant Team: University of Copenhagen – UCPH (Henrik Enevoldsen, Denmark), Institut Louis Malardé – ILM (Mireille Chinain, French Polynesia) and Institut de Recherche pour le Développement – IRD (Cécile Dupouy, New Caledonia)

Introduction

Ciguatera Fish Poisoning, a prominent non-bacterial seafood intoxication which affects various marine products such as fish and marine invertebrates, has become a growing concern not only in the Pacific but also at an international level, as evidenced at the PACE-NET Plus think tank workshop held in Nouméa in November 2015 on « Coastal ecosystem disturbances, fish and shellfish poisoning and their socio-economic implication ».

However, progress in CFP and toxic algae management programs is largely impeded by the lack of up-to-date knowledge about CFP and toxic algae occurrence and impacts in the Pacific. Hence, a pilot project entitled « Improving the knowledge base for Ciguatera monitoring and protection of public health and local economies in OCTs, Pacific Island Countries and Territories, Australia and New Zealand” was proposed in response to a PACE-NET Plus seed funding call, and approved in August 2015.

This project is steered by the University of Copenhagen – UCPH (Henrik Enevoldsen, Denmark), Institut Louis Malardé – ILM (Mireille Chinain, French Polynesia) and Institut de Recherche pour le Développement - IRD (Cécile Dupouy, New Caledonia). The proposed work included the organization of a workshop with relevant Pacific Island Country and Territory (PICT) representatives to develop a regional framework for compilation and sharing of CFP and toxic algae data.



PACE-NET Plus seed-funded workshop on
 “Improving the knowledge base for ciguatera monitoring and protection of public health...”

Key Workshop facts

The workshop was held in July 20-22, 2016 at the IRD Centre of Nouméa (New Caledonia) and reunited 10 participants from 8 different countries: Jacob Larsen (UCPH, Denmark), Cécile Dupouy (IRD=MIO, New Caledonia), Mireille Chinain & Clémence Gatti (ILM, French Polynesia), Dorothy Solomona (Ministry of Marine Resources, Cook Islands), Lyla Lemari (Marshall Islands Marine Resources Authority (MIMRA), Republic of Marshall Islands), Siola'a Malimali (Ministry of Fisheries, Tonga), Enelio Liufau (Service de l'Environnement, Wallis & Futuna), Susanna Piovano (The University of the South Pacific (USP), Fiji) and Bradley Moore (Pacific Community (SPC), New Caledonia).

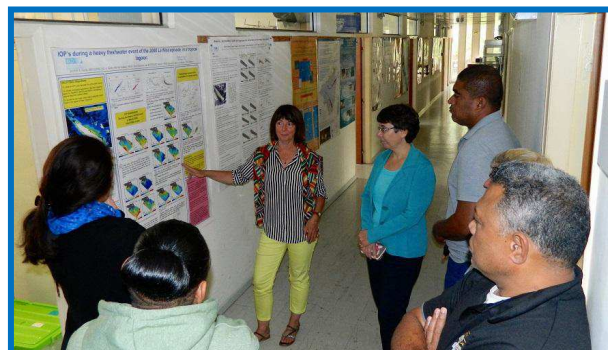
The following key activities took place during the workshop:

- ◆ Country presentations on the current status of CFP monitoring and related activities (including HAB species identification, benthic habitats study, census of traditional knowledge) in each participating PICT and identification of agencies and scientific partners (either local, regional or international) involved in these monitoring activities.
- ◆ Presentation of the Intergovernmental Oceanographic Commission (IOC) activities and its on-line tools (*e.g.* taxonomy reference list, HAB events databases websites)
- ◆ Review of current limiting factors with regards to the implementation of data collection/sharing programs for each participating country
- ◆ Visit of IRD laboratories involved in water quality monitoring activities: LAMA, US IMAGO and MIO culture laboratory.

Practical workshop outcomes

The following major limiting factors were identified as being common to all PICTs:

- ◆ A general lack of information and data about toxic events, incidence rates, toxic fish species (from local or external origins), lag time transfer of ciguatoxins in the food web, for forecasting and management purposes;
- ◆ Socioeconomic impacts of CFP are not sufficiently documented for most of the PICTs;
- ◆ For most countries, ciguatera monitoring is not allocated sufficient resources due to competing priorities and limited resources available;
- ◆ Limited data collating/coverage from remote islands;
- ◆ Lack of technical training on HAB species identification, sampling, culturing techniques, detection tests;
- ◆ Access and agreement on standardized protocols for collecting epidemiological data, field sampling, quantitative techniques, toxin analysis;
- ◆ Lack of regional/international synergies in some PICTs about certain fields of expertise (*e.g.* toxin detection);
- ◆ Lack of public and professional (fishermen, medical staff) awareness regarding toxic fish species, diagnosis of the disease.



Lessons learned

- PACE-NET Plus seed-funding was not sufficient to fund all relevant PICTs representatives (e.g. Samoa delegate could not be invited) despite additional support from various sponsors: Marshall Islands Marine Resources Authority (MIMRA), Service de l'Environnement of Wallis & Futuna and UMR-MIO of IRD.
- Current capacities in PICTs are not sufficient to ensure self-sustaining monitoring

Follow-up

1. Offer a master/PhD student scholarship from IRD through USP (MoU signed on June 30, 2016). Notification through USP/IRD channels and PACE-NET Plus participants (given priority). (IRD/USP; deadline: December 2016)
2. Synthesis of key literature available for free download through websites (entry to IODE for PACE-NET Plus participants). Check for forum/cloud possibility for information sharing. (IOC-UNESCO; deadline: September 2016)
3. Produce a list of PICTS currently involved in CFP monitoring activities (e.g. epidemiology, algae- or toxin-based field monitoring) and respective contacts.
4. Propose a common survey sheet to collect epidemiological data. (ILM; deadline: December 2016)
5. Agree on a common protocol for sampling procedures (microalgae and fish). (IOC-UNESCO/ILM); deadline: November 2016)
6. Produce a review manuscript on traditional knowledge on ciguatera for the participating Countries (scientific paper): deadlines: 1. screening of available information by **February 2017**; 2. provide a common questionnaire (in case of necessity); 3. Analysis of data; 4. Preparation of a manuscript (USP; deadline: January 2018)
7. Identification of a focal point for the PACE-NET Plus participants. Focal point will receive and distribute to Participating Countries information on calls for proposal and training opportunities. (ILM/IOC UNESCO; deadline: December 2016)

Perspectives

1. Draft of a proposal for potential funding (in particular for short term trainings)
2. Identification of potential contributors to future networking efforts (e.g. GOPS)
3. Contacting FAO to ascertain funding availability: each Country should check internal timeline and procedure and provide the information to ILM by end of **December 2016**.



The Pacific Centre for Social Responsibility and Natural Resources (PacSen)

Grant team: Prof John Burton (Divine Word University, Papua New-Guinea); Dr Glenn Banks (Massey University, New Zealand); Dr Pierre-Yves Le Meur (IRD, New Caledonia); and Mr Akuila Tawake (SPC, Fiji)

Introduction

A steering group for the Pacific Network on Social Responsibility and Natural Resources was established during the PACE-NET+ meeting that was held in Auckland in December 2014. In response to a call for proposal for the PACE-NET+ seed funding, the steering group prepared and submitted an application in April 2015. This application, among others, was approved in August of the same year and discussions were underway in organizing the workshop to present and discuss the establishment of this Network. Members of the steering group are: Prof John Burton (Divine Word University, PNG); Dr Glenn Banks (Massey University, NZ); Dr Pierre-yves Lemeur (IRD, New Caledonia); and Mr Akuila Tawake (SPC, Fiji). This workshop was necessary to bring all key stakeholders together to discuss how this Network will be established and its role in the region. It was agreed that this workshop was going to be held at the Pacific Community (SPC) in Suva by the end of 2015.

The Workshop

The workshop was organized by SPC and was held at the SPC Sub-regional in Suva Fiji between 16th and 19th November 2015 (Figure 1). A total of 16 participants attended the workshop. Apart from member of the steering group, senior government officials from PNG, Solomon Islands, and Fiji as well as representatives of the University of the South Pacific, and the Fiji Mining and Quarry Council participated in this event.



Figure 1: Workshop participants during a discussion session

In addition to the presentation and discussion sessions, a 1-day field trip to the Namosi Copper Joint Venture Project site (Figure 2), located about 40km to the north-west of Suva,

was organized by Fiji’s Mineral Resources Department. Mr Greg Morris, the manager of the Namosi Joint Venture gave an overview of the Project and also showed the participants some drill cores and two rehabilitated drill sites.



Figure 2: Workshop participants at the Namosi Copper Joint Venture site

Excellent exchange of views among participants occurred during the workshop particularly on (i) how this body would complement the activities of national agencies responsible for the management of natural resources in Pacific Island Countries (PICs), (ii) ways in which this body would facilitate collaboration among national agencies in the region, and (iii) influencing national policy and laws. Another interesting discussion revolved around the name of the consortium, whether it should be called a Network or a Centre. At the end of the discussion, participants have anonymously agreed that the consortium would be referred to as the “Pacific Centre for Social Responsibility and Natural Resources”.

Project Outcomes

At the end of the workshop, the following were agreed as the meeting outcomes:

1. The meeting was held in Suva with funding from the European Union, and the meeting agreed to establish a Pacific Centre for Social Responsibility and Natural Resources (the Centre).
2. The meeting agreed that the Geoscience Division (GSD) of the Pacific Community (SPC) to temporarily host the Centre pending funding and finalisation of governance arrangement. SPC is happy to host the Centre on a temporary basis and will communicate this to national representatives and we would like for national representatives to indicate support for this initiative and forward any comments.
3. Vision: To contribute to the improvement of wellbeing of the Pacific Communities through the responsible and sustainable management of the region’s natural resources.
4. The objectives of the Centre were to establish a Pacific knowledge hub addressing gaps in social responsibility in the use of natural resources :
5. Address gaps identified in national policies and capacities;

6. Build up monitoring and evaluation capacity;
7. Create a platform for social and scientific research , data and information, and policy development;
8. Collaboration with the government strengthening the existing processes and systems;
9. Promote the involvement of the Pacific Universities and research institutions in policy and development.
10. The next steps will include writing a concept note, identification of priority needs from government and relevant agencies, organising panel at the June 2016 STAR meeting in Nadi, Fiji, potential funding, and map out some research.
11. Explore potential partnerships to include research, academic, government and private sector.

Progress after the Workshop

It was recently decided that the “Pacific Centre for Social Responsibility and Natural Resources” would now be known in short as ‘PacSen’. One of the priority activities of PacSen is to look for funding to support its activities, and with Prof John Burton’s leadership the steering group has developed a concept note that will be used to attract donor funding to this initiative. This concept note can also be modified to meet any donor / development partner’s criteria for issuing funding support.



Fig. 3: Members of the PacSen steering group who presented PacSen at the STAR conference. From left: Akula Tawake, Pierre-Yves Le Meur, Martyn Namorong, Glenn Banks and John Burton

Additionally, it was decided that the STAR (Science, Technology and Resources) conference, held in Nadi Fiji on the 6th – 8th June 2016, would be an excellent opportunity to present PacSen to representatives of PICs, development partners, scientists, and social scientists who would attend the conference. The steering group (Figure 3) attended the STAR

conference and made a presentation on PacSen and it was well received by PIC representatives as well as other conference participants. A comment was made to ensure that PacSen is not duplicating another regional initiative, as well as the timing of establishing a regional initiative on social responsibility in natural resources development was commended.

Impacts

The PacSen is at its infancy and will take sometimes to take roots and produce some tangible impacts for PICs. The priority at the moment is to secure some funding to support the activities of PacSen and this is a challenge on its own. It is therefore recommended that PACE-NET+ (or a successor to PACE-NET+) should consider providing some initial funding to support the establishment of PacSen.

Lesson Learned

There is no agency at the national level in PICs that is responsible for social responsibility hence the need to establish PacSen. However, the Solomon Islands, under the guidance and potentially funding from the World Bank, is proposing to establish a "Natural Resources Independent Advisory Centre".

The PACE-NET+ seed-funding was not enough to fund relevant PICs representatives who should attend this workshop hence selected candidates from PNG, Solomon Islands, and Fiji were invited and supported to attend. Additionally, there is no full time employee of PacSen, and Mr Akuila Tawake – the current PacSen Coordinator, is coordinating PacSen activities despite his busy schedule as a fulltime employee of SPC. The steering group is aware of this hence its effort to win some quick funding to support the PacSen activities and to speed things up.

Kuchuwa Community Project: Indigenous Youth Responses to Water and Waste Management [Public digest version]⁴

Grant team: Micronesia and Australian Friends Association- ANU (Australia); Chuuk Youth Council-Kuchuwa (Fed. States of Micronesia); Univ. of Heidelberg (Germany); Albert-Ludwigs- Univ., Freiburg (Germany)

Introduction

The Micronesia and Australian Friends Association (MAFA) was awarded the PACE-NET Plus seed funding in 2015 to establish a pilot program to record indigenous youth responses to water and waste management and enhance community resilience to climate change in the village of Kuchuwa, in Chuuk Lagoon. This project focused on the impacts of climate change at a grassroots level in a relatively understudied region in the Pacific, with an inclusive approach that incorporated traditional community practices and knowledge and encouraged youth innovation and leadership. This project consisted of a youth-led needs assessment and gap analysis in Kuchuwa in January 2016, followed by a local workshop designed to mobilise youth and community leaders to build their capacity to understand and respond to climate change.



Kuchuwa youth workshop participants

⁴ The project organisers have also asked if a 'Public' digest version of the final report - 4 pages max, including photos, with a 20 line summary - could also be developed before the end of June. This would ideally concentrate on similar contents to the final presentation, as outlined in the letter (project outcomes, impacts, lessons-learned and experience gained by the seed-funding project consortium, although I imagine you'll need a paragraph of background and process too). The formatting is not important as it will be reformatted by the project manager into a common format alongside all the other projects to provide one public summary document of the seed-funding scheme - so it is an opportunity to showcase MAFA's work to the wider Pacific community and I hope you would be happy to provide this additional 4 pages.

Objectives

This project had three main objectives. The first objective was to conduct a needs assessment and gap analysis to understand the localised environmental impacts of climate change, and identify the water and waste management priorities of the community. The second objective was to build community capacity to adapt to climate change and specifically to empower the youth of Kuchuwa to actively participate in, and lead, community discussions about their changing environmental landscape. The third objective was to stimulate the design of innovative community adaptation strategies that combined local indigenous knowledge and Western technologies and research.

Outcomes

The main outcome of this project was the enhancement of community participation confidence in building resilience against climate change, specifically “climate action, resource use and efficiency, and raw materials” as identified by PACE-NET as a key priority. This was demonstrated by the youth-led climate action plans that were presented on the final day of the workshop which proposed to minimise the community’s environmental footprint by managing water and waste more effectively, with strategies to reduce reliance on unsustainable energy sources and manage raw materials more effectively.

This project also allowed the MAFA team to tailor a youth workshop with a specific community-based approach which acknowledges the importance of local and indigenous knowledge and practices. This builds on other climate adaptation projects completed in the Melanesian and Polynesian regions, but tailored to a Micronesian cultural context, with valuable educational materials translated into Chuukese for use in schools and community projects in nearby islands. This pilot project could serve as a template for new climate action plans which are focused at the community-level and introduce practical and effective waste and resource management strategies based on community consultation and youth leadership.

It provided an opportunity for MAFA researchers to take stock of past climate change plans and activities in the FSM, to document the current water and waste priorities of communities in the Chuuk lagoon, and to record indigenous approaches to environmental management. This is an important first step in climate adaptation when considering that the region is relatively unknown and understudied by the scientific global community. During the project, the MAFA team observed a lack of climate change education and awareness in Chuuk, compounded by the competing and overlapping activities of foreign NGOs and donor groups. Though some existing NGOs have been active in Chuuk in the climate change space for some time, it is not clear whether information is reaching communities at a grass-roots level, as demonstrated by Kuchuwa. Climate adaptation plans at a state and national level are limited by inadequate funding and a cumbersome bureaucracy, and we suggest that donor groups that work directly with local villages and communities are more effective in supporting climate adaptation. Lack of access to technical and scientific solutions is only part of the problem in Chuuk – our research argues that community practices often undermined foreign donor attempts to impose environmental reforms, and that this is a result of donor groups’ failures to address the interrelated human, social and cultural

factors that are closely tied to climactic and ecological hazards. We argue for a more localised community approach and one which focuses on youth participation.

Impact/Perspectives for the Future

One significant impact of the MAFA project is the sharing of knowledge, connecting Micronesian communities and researchers to European and Australian counterparts. The MAFA research collaboration connects several educational institutions, including the Australian National University, Heidelberg University, Munich University, the University of the South Pacific and the College of Micronesia. This collaboration has not only raised the profile of Micronesian communities in the international academic community, but it also connects Chuukese communities to a broader network of sponsors and organisations in Europe and Australia, and facilitates a translation process that connects academic research with local community knowledge and practical applications. The MAFA team has also tried to raise awareness about its project and climate change in the Chuukese diaspora, through social media and press releases, and by reporting to community groups and political leaders in Guam, Pohnpei and the outer islands of Chuuk.

MAFA has plans to continue strengthening the EU-Pacific partnership in the future with a focus on youth projects and climate change adaptation projects, subject to funding. One member, Manuel Rauchholz, is currently establishing a high school enhancement program in Chuuk State to be run by German volunteer teachers, which he expects to be operational by 2017. MAFA president, Gonzaga Puas, has been in communication with community leaders and officials in the low-lying islands of the Mortlock region in Chuuk. There is community interest in extending the same workshop there in the near future by connecting Kuchuwa and Lukunor Island youth, for example. Gonzaga has established a Micronesian research institute based in Pohnpei this year. Another member, Nicholas Halter, will be joining faculty of the University of the South Pacific and will be strengthening the USP relationship with Micronesia and Europe, providing a key link for Micronesian youth interested in further study abroad.

Another impact of this project has been to prompt local community interest in climate change adaptation, an issue which has become significant in recent months due to a long period of drought in Micronesia and the Pacific. Prior to the project, Chuuk had been severely damaged by Typhoon Maysak, evident in infrastructure damage and shipwrecks still visible on the islands today. MAFA's project in Weno and Kuchuwa preceded the FSM government's proclamation of a state of emergency due to high levels of drought, and our research suggested that few Chuukese were aware of the dangerous drought conditions that could be caused by El Nino, and had no water conservation plans in place. With the government struggling to rebuild in the wake of Typhoon Maysak, local communities are particularly vulnerable to other climatic changes like drought, and this project's focus on indigenous knowledge and practices will drive further innovation in climate change management at a local level, driven by local actors and community initiatives, rather than a top down approach from external organisations.

Finally, this project was successful in empowering local youth in Kuchuwa. Feedback from the community suggests that the youth were effectively engaged with the content, and

there was a broad consensus that proactive community action to manage water and waste was necessary for future prosperity. Since the workshop, youth participants have organized themselves to become a chartered youth organization. They have met to elect officers and have conducted major clean ups in Kuchuwa (*i.e.* collecting and separating garbage; clearing roads with their brush cutters and chain saws). Their most recent clean-up day was on April 16 where they reached another village of Nechap on Tonoas Island. MAFA identified youth as a crucial factor in the project’s success, noting that the Kuchuwa youth were enthusiastic and engaged, and were able to discuss sensitive cultural issues with the consent of their peers and elders. The Kuchuwa elders considered youth important for community renewal, particularly in dealing with contemporary issues such as education and climate change.

One of the key factors in this empowerment process was the involvement of two Chuukese researchers, Myjolyne Kim and Gonzaga Puas. They were crucial players in the MAFA project from conception to implementation, and during the workshop they were important Chuukese role models for the youth of Kuchuwa, demonstrating the benefits of higher education and the potential for youth leadership, as well as embodying MAFA’s project philosophy of incorporating indigenous knowledge with western frameworks. Their participation contributed to a strong sense of community pride amongst the participants. This workshop not only gave Kuchuwa youth an opportunity for peer mentoring by Myjolyne and Gonzaga, but it also provided a forum for young people to become leaders amongst their peers, and we identified several individuals who showed particular promise. It is hoped that MAFA can continue to maintain a strong relationship with Kuchuwa and support these potential young leaders.



MAFA member Manuel Rauchholz answering questions during a break in the workshop

Pre-feasibility study for methane recovery at Naboro landfill, Suva, Fiji

Grant team: The University of the South Pacific (Reg.), NV Afvalzorg (Netherlands); National Institute of Water and Atmospheric Research-NIWA (New Zealand)

Summary

Methane is a strong greenhouse gas with the Global Warming Potential (GWP) of 21, meaning on a molecule to molecule basis, methane is stronger than carbon dioxide by 21 times in terms of trapping infrared radiation and causing global warming. One of the major sources of atmospheric methane is anaerobic decomposition of organic waste in landfills. In the absence of methane recovery and utilisation technologies the methane produced in the landfills are vented into the atmosphere adding to our greenhouse gas inventory.

Fiji has only one sanitary landfill, Naboro landfill, in Suva receiving an average of 70,000 tonnes of waste annually. There are four stages of operation and currently Stage 1 is almost completed. The PACENET PLUS seed grant was awarded to look into the feasibility of methane recovery at Naboro landfill. The project entailed carrying out an intensive field work for 1 week to estimate methane emissions and to ascertain the oxidation rate of methane in the field. The data obtained were then used to execute the AFVALZORG multiphase model to calculate the landfill gas generation rates and landfill methane that can be recovered.

Based on the type of waste deposited and the tropical weather conditions, it was calculated using the model that approximately 800 m³/h of methane will be generated in 2016 and will rise to a maximum of 1600 m³/h by the end of stage 4 of the landfill. The model results show that the use of horizontal wells reduce the yearly average emission to 55% of total methane generated. This highlights the fact that approximately 45 % of the methane generated could be harnessed and could be utilized to generate energy using gas engines. However a large fraction of the methane generated is still lost as emission to the atmosphere and this can be further reduced by enhancing the oxidising capacity of the soil cover. It was noted that methane recovery and utilisation at Naboro landfill could be a viable option.

Background

There is only one sanitary engineered landfill in Fiji which is in operation since 2005. The landfill is administered by the Government of Fiji and is operated by a private contractor, H.G. Leach Company of NZ. The landfill caters for household, commercial and industrial waste from areas around Suva, Nasinu, Nausori, Navua and Korovou. The landfilling at Naboro is planned in four stages and the stage 1 was filled in Jan 2016. Below is the layout of the different stages of the landfill.



Dr. Mike Harvey from NIWA (left), Dr. Francis Mani (middle) and Dr. Maata from USP (right) are busy doing static chamber measurements to estimate methane and CO2 emissions to ascertain oxidation rates.

The landfill methane generated at Naboro is emitted to the atmosphere adding to Fiji's national greenhouse gas inventory. This project used the state of art technology such as TDL methane analyzer from NV Afvalzorg and the mobile static chambers

to carry out in-situ methane flux measurements.

The ratio of carbon dioxide to methane was also calculated to ascertain the oxidation rates at the landfill. Using the model the total landfill methane generation rate was calculated. The Afvalzorg Multiphase Landfill Gas Generation and Emission Model was used to calculate the percentage of methane recovered for different stages was based on the waste composition, duration of the individual stages and the tropical wet climate. The study aims to propose options for methane recovery and utilisation and thereby reduce greenhouse emissions. This is probably the initial screening study done to estimate methane flux and model results for methane recovery for a local landfill in the Pacific Island Countries (PICs). The results obtained in this project will address the PACE-NET Plus project goal of encouraging and supporting the EU-Pacific ST&I cooperation, focusing on societal challenge of "Climate Action, Environment Resource Efficiency and Raw Materials". The proposal aims to develop awareness, technological options and strategies to reduce carbon footprint from the waste sector and finding solution to reducing the national greenhouse inventory.

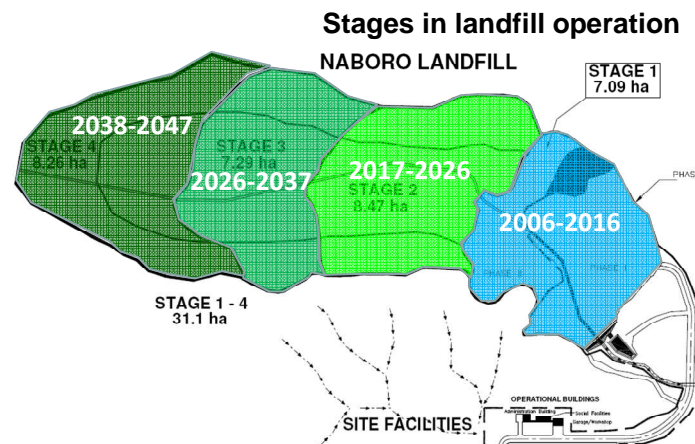


Fig. 1: An illustration of different stages, hectares and operation timelines of different stages at Naboro landfill

Project Outcomes

An intensive 1 week fieldwork in early January 2016 was carried out and the following outcomes were achieved:

Field measurements show that methane emissions for hotspots ranged from $76.48 \text{ g CH}_4 \text{ m}^{-2} \text{ d}^{-1}$ – $6,345.05 \text{ g CH}_4 \text{ m}^{-2} \text{ d}^{-1}$.

As the landfill methane migrates through the oxidation top soil layer it was observed that there was an oxidation loss of 10.3%. This experimentally obtained oxidation loss is very close to the IPCC default value of 10%.

The field data obtained was used in the model to calculate the landfill gas generation rate, which is currently standing at $800 \text{ m}^3/\text{h}$ at the end of stage 1 and is estimated to increase to $1600 \text{ m}^3/\text{h}$ at the end of the life of the landfill.

The model also showed that given the waste composition and tropical wet conditions, methane is generated very quickly and lost to the atmosphere. Hence the technology for efficient recovery of methane is installing horizontal wells, that is, laying gas recovery pipes horizontally in the active waste cell and piling rubbish over it. Hence the efficiency of methane recovery is increased as more of the methane is recovered as it is produced in the landfill.

Using a conservative approach, the results obtained shows that using horizontal wells to recover landfill methane and utilising it to run gas turbines to generate electricity could reduce our carbon footprint by 27 000 tons of CO_2 equivalent per year.

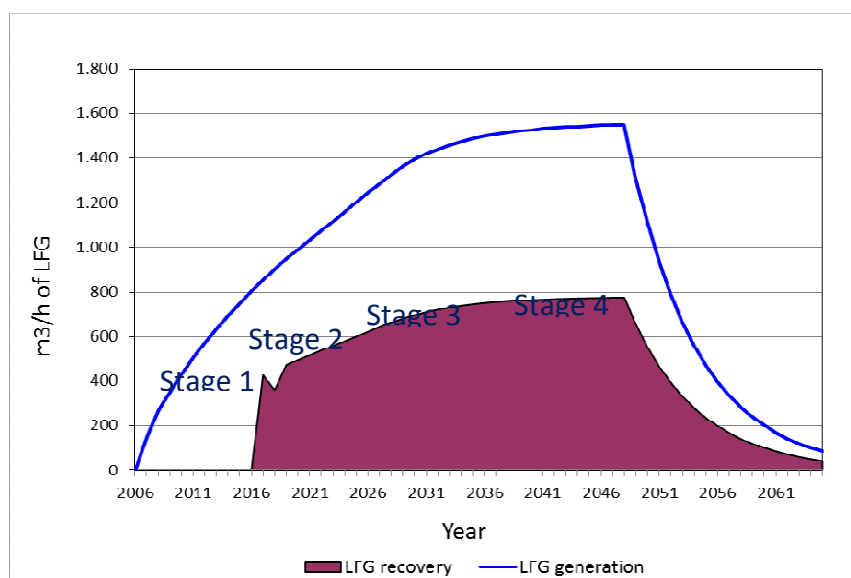


Fig. 2: LFG recovery vs LFG generation

A rough estimate shows that a total investment of FJD 3.9 million would be needed to recover and utilise methane in a gas turbine to generate electricity for 10 years. This rough calculation also showed that a revenue of 1.3 million per year could be generated through its own consumption for the operation of the landfill and feed-in to national grid.

Impacts

The data obtained in this project was shared with relevant stakeholders such as the Landfill operator (HG LEACH), Department of Environment, Climate Change Division and EU-GIZ. The stakeholders agreed to develop a strategy paper that attracts the attention of investors or other stakeholders such that a full-scale feasibility study and eventually a methane recovery and utilization project are funded and executed.

The project managed to bring the EU landfill expert from Netherlands, a greenhouse gas specialist from New Zealand and the local expert together to collaborate on quantifying emissions from the landfill and propose feasible mechanism for methane recovery and utilization. Discussions and collaborative efforts are still underway between the three parties as to how we can do further research or way forward in reducing greenhouse gas emissions from the landfill. In fact AFVALZORG has actually donated an instrument (mobile GC) to boost our capacity to do more in-situ measurements in field and this would not be possible without the cooperation established in this project.

Lessons learned

The collaboration between EU and PICT was beneficial in this project and it led to some tangible outcomes. We learnt that the Naboro Landfill has the potential for methane recovery and utilisation to reduce our national carbon footprint.

The climate change division during the stakeholders meeting informed that this could be ideal project that could be funded under the “Green Climate Fund”. The Climate Change Division is extremely interested in this project and we have shared the data with them.

Through this project we were able to develop our own capacity in terms of methane measurements and using the model to estimate landfill gas generation and recovery.



Mr. Richard Gronert from NV AFVALZORG Netherlands using specialised state of art technology to measure methane emissions from the Naboro Landfill.



A USP student using specialised instrument to scan the landfill surface for “hotspot” emissions.

Identifying ecological risk assessment tools and approaches for deep sea mineral activities to support communities, government, and developing industries in the South Pacific.

Grant Team: Associate Professor Amanda Reichelt-Brushett; Dr. Judi Hewitt, Mr. Paul Lynch, Dr. Stefanie Kaiser, Mr. Ray Wood, Dr. Rakhyun E. Kim

Summary

This project contributes to two PACE-NET plus project goals, the main one being ‘the protection and sustainable management of natural resources and ecosystems’ which is part of the Climate Action, Environment, Resource Efficiency and Raw Materials goal. The other goal it contributes to is Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy. Deep sea resource extraction is a fledgling industry that has limited guiding principles, protocols and regulations. Through this seed funded project we ran a workshop in New Zealand with stakeholders from a broad range of interests associated with deep sea mineral activity. The workshop focussed on a six step engagement and from the workshop discussions we have highlighted the priority target approaches to risk assessment and risk minimisation. We present *concepts to develop a draft framework for ecological risk assessment for deep sea minerals activities; identify tools and techniques for quality risk assessment; and identify what values of deep-sea ecosystems are important to stakeholders* and how threats to these can be managed and minimised. Discussions highlighted the importance of trust and/or respect between stakeholders; valuing the ‘life force of the ocean’ and sharing data. This research highlighted the need for a holistic multidisciplinary approach that connects science, management, industry and community. Such a multidisciplinary approach is not evident in the other identified projects in various jurisdictions that focus on deep sea mineral activities and there is an opportunity to benefit from further multidisciplinary study in the context of our expanding knowledge in this field.



Rak Kim (Australia) (back left) with workshop participants from left to right Linda Faulkner (New Zealand), Teina Mackenzie (Cook Islands), Joseph Brider (Cook Islands), Maree Bartlett (New Zealand).



PACE-NET Plus seed funded workshop on “Identifying ecological risk assessment tools and approaches for deep sea mineral activities”

Key Workshop Points

This Workshop took another step in the regional approach to putting in place a comprehensive, sustainable and effective seabed minerals activities management system-Objectives:

- ♦ to identify the concepts needed to develop a draft framework for ecological risk assessment for deep sea minerals activities;
- ♦ to identify tools and techniques for quality risk assessment; and
- ♦ to contribute to identifying what values of deep-sea ecosystems are important to stakeholders and how threats to these can be managed and minimised.

Concepts needed to develop a draft framework for ecological risk assessment for deep sea minerals activities

Concepts drawn from the workshop are highlighted below in no particular order of priority

CONCEPT 1	The three main types of deep sea mining will have different types of impacts and may need to be managed differently: 1/ Polymetallic nodules (also known as manganese nodules) 2/ Polymetallic sulphides (seafloor massive sulphides or crusts) 3/ Hydrothermal minerals (cobalt-rich ferromanganese)
CONCEPT 2	Data sharing is essential, and indigenous knowledge and scientific knowledge are both useful
CONCEPT 3	Adaptive management and staged developing of mining activities are based on learning from the process and informing the current unknowns. Together they provide a mechanism to develop a social licence in the face of uncertainty.
CONCEPT 4	There are times where activities might need to be halted (<i>e.g.</i> peak spawning events)
CONCEPT 5	Trust and/or respect between stakeholders is required
CONCEPT 6	It is essential to identify who the owners of the resource are at the conception of the project and how the resource is allocated among users. The owners may be responsible for assessing the project and agreeing on conditions, or this responsibility may be delegated to a regulatory authority. There is also the possibility for confusion between “legal” owners and local users and whether local communities feel that delegation to a regulatory authority has actually occurred.
CONCEPT 7	Intergenerational equity and decisions about the ‘right time’ to exploit a resource need to be part of the process of considering a project.
CONCEPT 8	If a project is approved then the conditions need to stipulate how unexpected events will be managed. Should bonds or insurance be required?
CONCEPT 9	Cumulative impacts need to be part of the project assessment process, and these may be intergovernmental <i>i.e.</i> linked to understanding ‘tipping points’.
CONCEPT 10	Consideration of a project must recognise the challenges of understanding ecosystem interactions, whether food chains, energy flows or dispersal of organisms.

Tools and approaches to develop quality risk assessment

TOOL/	Development of a Leopold ‘like’ Matrix template (identify likelihood of specified
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APPROACH 1	impacts and rate the importance value in 'this' case). These matrices may be layered and have social, cultural, and ecological layers defining likelihood of impacts and importance values for each context. This will help to: understand how to weigh cultural values and ecological values together; define a process to determine the right questions; determine how to ask the right questions
TOOL/ APPROACH 2	Develop a shared database of South Pacific deep sea biodiversity data and support the understanding of food chain interactions and flow between the deep, middle and upper ocean.
TOOL/ APPROACH 3	<p>Develop 'trigger values' or 'trigger phrases' that can support adaptive management. This was a complex discussion point and highlighted the need for clear actions to be developed with industry, communities and agencies about</p> <ul style="list-style-type: none"> • what to do when a trigger point is reached, • the difficulty in defining a trigger if the response is linear • the limitation of present research looking at tipping points and threshold responses. • Response to multiple stressors <i>i.e.</i> the more stressors that are operating on a system the more likely a threshold response will be reached. Should triggers be set in isolation of climate change and fishing impacts etc.? <p>Triggers will need to be informed by research but will need to resolve:</p> <ul style="list-style-type: none"> • What are 'significant' impacts? • What is an 'acceptable' change? <p>Research needs:</p> <ul style="list-style-type: none"> • Some standardised definition of "significant" or a process to determine the definition for the specific activity/location is required. In order to obtain such a definition knowledge of what is there, what is likely to be impacted and the degree to which impact on sensitive components is likely to flow on to other ecosystem components is required • A social science process for obtaining local cultural/community objectives and integrating these into the definition of "acceptable". • Information on natural (baseline) spatial and temporal variations of ecosystem components and services is necessary. This requires research in a number of fields but importantly includes: Best practice monitoring; Identifying key ecosystem components; Determining organism and energy connectivity between locations etc.
TOOL/ APPROACH 4	Develop protocols for deep sea sampling to inform 3.
TOOL/ APPROACH 5	Develop species sensitivity curves (ecotoxicology) for toxicants in deep sea environments to inform 3. Toxicants in this case may include unmodified sea floor material.
TOOL/ APPROACH 6	Consider how life cycle assessment (LCA) tools may be adapted and used to assess deep sea mining projects to capture their value and help realise economic, social and environmental costs and benefits to the community.

Other related studies/activities

This seed funding project is not the first project to attempt to tackle consequences of deep sea mineral activities and there is a growing knowledge about deep sea environments that can inform management decisions.

- ◆ Exploring the Sustainable Development Potential of Environmentally Sensitive Deep Seabed Mining Sponsored by South Pacific Developing Countries
- ◆ SPC –Secretariat of the Pacific Community
- ◆ 45th Underwater mining conference (Korea) <http://www.underwatermining.org/>
- ◆ The 5th Annual Deep Sea Mining Summit 2016 (London) <http://deepsea-mining-summit.com/>
- ◆ The Deep Ocean Stewardship Initiative (DOSI)
- ◆ Project Eco-DEEP 2015
- ◆ Project EMOM 2012-2016
- ◆ MIDAS (Managing Impacts of Deep Sea Resource Exploitation)
- ◆ International Seabed Authority

Future goals

This study and seed grant project had been developed in conjunction with other initiatives (section 5) that seek to explore common issues associated with deep sea exploitation. Many of these other initiatives have been one off events and come to a close in 2016/2017. The workshop identified areas of risk assessment that are not currently being addressed but could be informed by the progress made in other initiatives. The main knowledge gaps identified in this workshop that have had little attention elsewhere is developing of tools and approaches that connects to the nexus between science and management needs. The development of this connectivity requires multidisciplinary action and community involvement. The concepts, tools, approaches and values identified here make up a sound base for future research directions and actions for a much larger multidisciplinary research effort that could develop trust and/or respect between stakeholders in the South Pacific. Such research effort will require a multidisciplinary approach that connects science, management, industry and community and it should be managed as a holistic process. We would welcome the opportunity to develop a proposal around this concept.

Communication, communities and climate change-designing a leadership program for community-based climate change practitioners in the Pacific region

Grant Team: Prof. Elisabeth Holland, University of South Pacific-PACE-SD (project leader); RMIT Univ. Melbourne (Australia); Foundation of the Peoples of the South Pacific Islands (Fiji & partners: Kiribati, PNG, Solomon Islands, Tonga, Tuvalu); Universitat Autònoma Barcelona (Spain)

Introduction

The PACE-NET Plus seed funding enabled design, implementation and evaluation of a unique Leadership and Communication program that supported the Pacific Islands Nations (PINs) during the UNFCCC 21st Conference of Parties (COP21) negotiations

Pacific Island students and civil society members undertook the innovative four-day program before accompanying the Pacific delegation to COP 21, Paris. The international, multi-disciplinary team, comprising three universities from Australia, South Pacific and Spain respectively, and led by Prof. Elisabeth Holland (USP PACE-SD), used Participatory Action Research (PAR), to assess participant learning needs and to design the interactive program. Post-program evaluation indicates that climate science, climate finance, leadership, negotiation, media and communication capacity building contributed to the strong voice of Pacific Island Countries during COP 21, Paris.

This report describes the process undertaken to develop, implement and evaluate the program, and provides an outline of the one-week intensive training program that participants undertook in October 2015. Outcomes include a recommendation to build on the success of this program to develop an adaptive PAR-based leadership and communication capacity building program for the Pacific region that can be modified to meet the specific needs of different contexts.

Learnings from the capacity building program, and strategies to build on the strengths and weaknesses of the pilot program in order to develop a sustainable, adaptive CC Capacity Building program for emerging climate change leaders in the Pacific are documented in the report.

Background

A **review of literature** in adaptive leadership, participatory communication and social planning informed design of the pilot CC capacity building program (CC Program). The theme to emerge from the literature review was that climate change leadership requires specialist skills and support systems that assemble information for the purpose of preparedness. The resulting CC Program builds on and goes beyond past and current leadership, communication and social planning by designing, implementing and evaluating an innovative training program to increase capacity in leadership, dialogue and cooperation, strategic thinking and media advocacy for local level climate change practitioners in the Pacific. The aims of the four-day program were:

- Engage in learning new skills and approaches for working collaboratively with local, national and regional stakeholders to communicate and integrate science into practice in order to make a strong, positive impact on decision-making.
- Model effective media and communication practices to contribute collective knowledge building, and examples of best practice and sustainability in climate change adaptation in the Pacific, during COP21.
- Develop best practices, and sustainability, for an ongoing climate change capacity building program for the Pacific Island Nations.

Theoretical framework

A summary of how concepts from participatory communication, social planning and adaptive leadership informed the CC Program, follows.

Participatory communication was used as a guiding framework to provide climate change initiatives with methods for participants to engage in joint problem-solving, relationship-building, dialogue and listening in order to enhance public participation. Thomas Tufte's definition of participatory communication as 'a process of public and private dialogue through which people themselves define who they are what they need and how to get what they need in order to improve their lives' (2009:2), was accepted. The tenets of participatory communication include dialogical rather than linear communication, collective problem identification, decision-making and implementation of solutions (Tufte, 2009).

Collaborative planning is a method of **social planning** that can reduce power imbalance and build social capital by strengthening cross-scale stakeholder engagement, capacity building and deliberation. With increasing recognition of social and cultural influences on CCNDRR, collaborative planning responds to an urgent need to build cross-sectoral collaboration between scientists, policy makers, practitioners, and residents (IPCC, 2014a, 2014b; UKCIP, 2011; UNISDR, 2014). This CC program builds on Goldstein's collaborative planning model by using participatory communication to identify local climate change leaders' capacity building needs, in order to enhance their ability to support cross-scale deliberation across levels of government, jurisdictional and local boundaries during COP 21 negotiations.

Concepts from **adaptive leadership** were drawn on, as a key strategy used to address the impacts of climate change in the Pacific is adaptation. With a foundation in leadership theory, but with significant links to scientific theory, the adaptive leadership approach draws on biology and evolution where plants and animals evolve (or adapt) over time in order to survive and thrive. In contrast with more traditional leadership training, adaptive leadership training focuses less on general 'characteristics' of leadership, and more on the practical exercise of leadership for change. Heifetz *et al.* (2009) five qualities of adaptive leadership were incorporated into the leadership training schedule: (1) elephants in the room were named, (2) responsibility for the future was shared, (3) independent judgment was expected, (4) leadership capacity was developed, and (5) reflection and continuous learning were institutionalized (2009:101).

The four-day CC program

The CC program (Attachment 1), allowed participants to build capacity in climate change science within the context of the South Pacific, to better understand the COP 21 negotiation process and the Pacific position to be taken at COP21, and to strengthen their leadership, diplomacy, and strategic communication skills, including media advocacy, in preparation for Paris. Workshops were framed within the following themes:

- | | |
|--------------------------------------|------------------------------------|
| Climate change science | Adaptive leadership |
| Diplomacy and diplomatic negotiation | Strategic communication management |
| Communication planning | Presentation and media skills |

The COP 21 capacity building program was designed within a participatory action framework (PAR), to demonstrate the methodology to participants, but also to provide reflexive exercises where participants could share relevant knowledge, skills and personal stories. The PAR format provided a platform to build trust and collaborative action amongst participants, not only in preparation for COP 21, but for future South Pacific CCNDRR projects. Trust is a vital component of resilience building (Walker and Salt, 2012). Activities were structured to create a safe space for discussion whilst building a common appreciation amongst the participants of their respective skills and capacities. Collaboration of this kind can facilitate resilience building both from the perspective of individual actors in their home organisation but also in exploring the pressures to communicate and collaborate with other experts, and most important for this case study, with diplomats and world media, during the two weeks of COP21. By doing so, the PAR methodology would lead to an inter-agency network where more collaborative community resilience practices could emerge. The series of workshops provided opportunities to model both vertical and horizontal communication amongst a wide range of representatives including 3 universities, students and residents from seven South Pacific island nations and territories, and South Pacific local and regional-level community-based organisation (Figures 1 & 2). PAR was deemed essential to amplify the voices of those who have done least to contribute to climate change, but who are the most severely affected (Robinson, 2010).



Figure 1 and 2: Adaptive leadership, team building and negotiation

Participants

Pacific Island students and NGO representatives were selected to support their national delegations during the COP 21 negotiations⁵. Selected students were University of the South Pacific (USP), postgraduate journalism, climate change, and law students, whilst the NGO representatives included a cross-section of local and regional community based organisations (Appendix 2). This group was invited to join the CC program, as part of their preparation to support the Pacific Island delegations. The delegations attending COP 21 comprised political leaders from Vanuatu, Tuvalu, Republic of the Marshall Islands, Solomon Islands, Tonga and Fiji, and the Pacific Islands Development Forum (PIDF).

Evaluation

Post-COP 21, a second PAR workshop was held at the University of the South Pacific (USP), Suva (December 16, 2015). The one-day workshop was an opportunity for participants to de-brief after their return from Paris, to reflect on the outcomes of 'The Paris Agreement' reached at COP21, and on their roles in supporting their respective delegations. The day commenced with a summary of 'The Paris Agreement' by Dr Morgan Wairiu, Deputy Director of University of the South Pacific's PACE-SD⁶. This was followed by round-table discussions between participants and researchers. Each participant spoke individually of their personal highlights during COP21, and their respective roles during the negotiations. General discussion followed each person's narrative, as participants engaged in reflective group dialogue. Participants and researchers were encouraged to synthesise their journey undertaken, and to verbally reflect on lessons learnt (positive and negative). This process provided the researchers with valuable feedback regarding the strengths and weaknesses, opportunities and gaps, of each phase in the CC program. Participants gave honest and frank opinions when asked about the strengths and weaknesses of the training program provided (Table 1).

Table 1: Evaluation of CC program

Strengths	Weaknesses
negotiation, communication, leadership and climate science built participant capacity for COP21.	Sessions on negotiation could have commenced earlier; further capacity building in this topic.
Importance of the role-play undertaken during the leadership session.	Strategic communication session too late in program. Needs to precede media training.

⁵ USP's European Union Global Climate Change Alliance (EUGCCA) Project supported 7 people on the USP team, one staff and one student are funded by USP's School of Law while the School of Governance, Development and International Affairs (SGDIA) funded one student be part of the team going to Paris.

⁶ PACE-SD Pacific Centre for Environmental and Sustainable Development, University of the South Pacific.

Leadership session acted as the trigger for establishing horizontal communication channels between all members of the COP21 support group (formerly competing NGO's, students and journalists).	Not enough direct link of skills training to the white papers that were the focus of negotiations, communication and dialogue at COP 21.
The practical session on digital media led by one of the NGO participants, was noted as particularly useful in establishing social media links- and to maintain contact between the team, to ensure adequate rest and support when needed.	Participants needed to have personal stories ready to publish and circulate via media at COP21, to give visual impact of CC.
Media training valuable.	

Where to from here?

The four-day CC program provided a pilot study in the use of participatory action research to assess capacity needs in order to design, implement, and evaluate an interactive Leadership and Communication program. The process to develop leadership, communication and collaborative planning capacity of emerging Pacific climate leaders, has potential to address the 'wicked problem' of *how* to enact the landmark Paris Agreement, to reduce the impact of climate change and manage disaster and development risks.

We have written a paper describing the project in full (Appendix 3), and submitted it to the academic journal "*Environmental Communication*" for review. It is our intention to extend this pilot project to develop a Leadership and Communication program for emerging climate leaders across the wider Pacific region that can be modified to specific contexts, including CO22 Marrakesh, and the UN Oceans Meeting, 2017.

If we receive the remaining funds 5,977 Euros from our PACE-NET Plus Seed Funding, we have a balance of 4014.21 Euros unspent as of 13 June 2016. The reason for the unspent funds is that we had unexpected donations of venue hire, catering and TV camera hire (Appendix 4 Expenditure).

We propose to use these remaining funds, 4014 Euros to provide the following resources to provide Leadership, Diplomacy and Communication capacity building for the Pacific students and NGO's attending COP22 Marrakesh with their National Delegations in November 2017 (attachment 5 Projected Expenditure Phase 2).

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TPOS2020: Tropical Pacific Observing system for 2020

Grant Team: CSIRO (Australia), Institut de Recherche pour le Développement-IRD (New Caledonia); PI-GOOS/SPREP Apia (Samoa)

Introduction

The TPOS 2020 Project (<http://tpos2020.org/>) is a focused, finite term international project, which is just starting and will be completed in 2020. It will evaluate, and where necessary provide guidance to change all elements that contribute to the Tropical Pacific Observing System (TPOS) based on a modern understanding of tropical Pacific science.

Learning lessons from the great success-and finally partial collapse- of the TAO/TRITON array existing since the 90s, the project objective is to build a renewed, integrated, internationally-coordinated and sustainable observing system in the Tropical Pacific, meeting both the needs of climate research and operational forecasting systems.

The scientific objectives are:

- ◆ To redesign and refine the TPOS to observe El Niño Southern Oscillation (ENSO) and advance scientific understanding of its causes,
- ◆ To determine the most efficient and effective observational solutions to support prediction systems for ocean, weather and climate services,
- ◆ To advance understanding of tropical Pacific physical and biogeochemical variability and predictability.

TPOS2020 is coordinated by a steering committee with task teams working on specific aspects of the observing system. The TPOS2020 project also opens partnerships with the meteorological community, and the coastal and regional ocean communities. In particular, it wishes to include the Pacific Island Countries in the process.

The "Backbone" task team (<http://tpos2020.org/task-teams/backbone-task-team/>), whose main objective is to articulate the purpose and requirements for the "backbone" observations in the Tropical Pacific, is chaired by Susan Wijffels from CSIRO (Australia) and Sophie Cravatte from IRD (New Caledonia). ***The financial support from PACE-NET Plus allowed to organize the first face-to face meeting of the backbone task team***, consisting of 15 members from various countries around the Pacific (Japan, Korea, China, USA, France and Australia). This workshop was held on 16-18 September 2015 at the IRD Centre in Noumea, New Caledonia. The goals of the workshop were to prepare the first set of recommendations on changes to the Backbone observing system.

In order to consider the needs of the Pacific Island Countries when building the observing system, we invited Dr Tommy Moore from PI-GOOS, who did join us as an expert for this first meeting, to present the observations existing and the needs for Pacific Islands Countries.

Key Workshop Points (16-18 September 2015, Nouméa, New Caledonia)

Attendees

The members of the Backbone Task Team attending the meeting were: S. Cravatte (IRD, New Caledonia), W. Kessler (NOAA, USA), T. Lee (JPL, USA), D. Roemmich, J. Sprintall (Scripps, USA), S. Wijffels (CSIRO, Australia) and L. Yu (Woods Hole, USA). In addition, several members were able to join the meeting by video-conference (K. Ando (JAMSTEC, Japan), A. Ganachaud (IRD, France), M. Wheeler (BOM, Australia). P. Strutton (University of Tasmania, Australia), C. Menkes (climatologist at IRD), J. Aucan (In situ sea level expert, IRD) and two external people, Shayne McGregor (ENSO dynamicist from Monash University, Australia and Tommy Moore (Pacific Island GOOS Regional Association) were invited. Lucia Upchurch (NOAA, USA) was also attending, providing support and helping for the logistics and notes, in replacement of Ana Lara-Lopez who couldn't attend.

Contributions supporting the meeting came from PACE-NET Plus Seed funding for expert participant travel and local costs, and from NOAA Climate Office Division and NASA for TT members and project management travel.

The goals of the meeting were to prepare the first set of recommendations on changes to the Backbone observing system for the SC. More specifically, the goals were:

- to design one (or several, if no consensus was reached) strawmen of mature and affordable technologies with 3 levels of priority and justification: a- essential elements that contribute to all requirements; b-elements that contribute to several requirements; c-elements needed for 1 or two requirements
- to make a list of pilot elements that can contribute to a future TPOS that can be tested now
- to make suggestions for a transition plan that reduces risk (not done)
- to prepare a list of gaps/questions to address with other TT or community experts

Outcomes and main discussions

During this 3-day meeting, there were many discussions that cannot be summarized here. The main outcome is a strawman that addressed the three levels of priorities noted above, and detailed in the next paragraph.

Much discussion focused on improving surface flux estimation, and about the role of a broadscale buoy observations for wind estimates (by satellite or reanalyses). The BB TT was informed that:

- impact of the current broad tropical moored array (TMA) sites is weak on the global calibration of the winds from an individual scatterometer since tropical winds have a low dynamic range (but the sensitivity of the global coupled system to those winds is high).
- a big issue is rain contamination, and there is a strong need to measure winds in rainy places (e.g. far West Pacific and the atmospheric convergence zones) For satellite retrieval algorithms, buoys can be more helpful if they can provide wind measurements under various rain conditions (e.g., light, moderate, heavy rains).

- key sites with long-term coverage is extremely important for cross-calibrating the winds from different satellite platforms and building a windstress climate record
- reanalyses should ingest scatterometer winds – not all do and those that don't suffer from serious artefacts around moored buoys as a result

There were also discussions on the consideration of financial investments in the process of strawmen design. It was agreed that requirements for the observing system should be the primary factor in initial system design, and precede the cost analysis. However, the cost-effectiveness of individual elements should be weighed and will ultimately determine what can be implemented and sustained. Also, parameters should not be arbitrarily added because they are cheap, but rather, should all be scientifically justified.

It was also concluded that more expertise on coupled modeling was needed in the BB TT, and we have invited Andrew Wittenberg (GFDL/NOAA) to join the team.

Progress after the Workshop/Future goals

At the end of the workshop, great progress had been made on the TPOS2020 backbone design. The outcomes were presented at the second meeting of the TPOS2020 Steering Committee, held in Hobart (Australia) from 14 to 17 October 2015 (<http://tpos2020.org/project-reports/steering-committee-reports/steering-committee-2-interim-meeting-report-2016/>). ***PACE-NET Plus funding also provided financial support for Sophie Cravatte's travel.***

At this meeting, three different solutions were presented for the Backbone, at one extreme building enhancements on top of the existing networks (assuming all were maintained fully functional) and taking a very broad interpretation of “cornerstone/fundamental”, and at the other imposing some stratification based on requirements and perceived levels of scientific and societal utility and impact, and employing a much tighter “cornerstone/fundamental” filter. At this end of the spectrum, “fundamental” implies there are multiple uses

The TPOS 2020 Steering Committee agreed to provide a sequence of three Reports on this work, the first of which is this Interim Report to be finalised and published in the last quarter of 2016. Responsibility for drafting the Interim Report has been delegated to the TPOS 2020 Backbone Task Team with the Co-Chairs of that Task Team acting as the Coordinating Lead Authors for the Report. Other Task Teams provided critical input and support. A first draft had been submitted for review to 38 external reviewers in April 2016. ***For the review process, Sophie Cravatte spent two weeks in Seattle at NOAA in June 2016, and part of this travel was supported by PACE-NET Plus.***

This report has been recently finalized and is publicly released (<http://tpos2020.org/first-report/>). As an Interim Report, it contains provisional conclusions and findings based on the work and discussions to date; it provides stakeholders and sponsors an early indication of the priorities and direction being taken by TPOS 2020 and an opportunity for feedback and, as appropriate, adjustment to the scope and goals of the Project. This Interim Report discusses the background that will inform a redesign, including the varied communities that benefit from the observing system, the sampling needs arising from those potential benefits, and the techniques and strategies available to meet them.

Impacts

The PACE-NET Plus funding has been absolutely essential for starting, and finalizing the First Report of TPOS2020. This report is a very important piece of work that will progressively guide international stakeholders on recommended changes for the ocean/atmosphere observing system in the Tropical Pacific for the next 20 years.

This project did:

- address a major societal challenge, which is observing the ocean and atmosphere, to help understanding and predicting the El Nino phenomenon, and the climate variability, from extreme events to climate change in the tropical Pacific
- strengthen Pacific-EU research cooperation and partnerships, through cooperation between Australian, French, Pacific Islands researchers, as well as Japanese, Chinese, Korean and American researchers.

Lesson Learned

Most of the work within the TPOS2020 project is made through videoconferences. However, a workshop with a face to face meeting, as organized in Noumea and a short visit in laboratories is essential to make significant progress. The 3 days workshop in Nouméa has been key for discussing the scientific priorities and starting to conclude on key recommendations for the future of the Tropical Pacific Observing System.

Photos & Figures

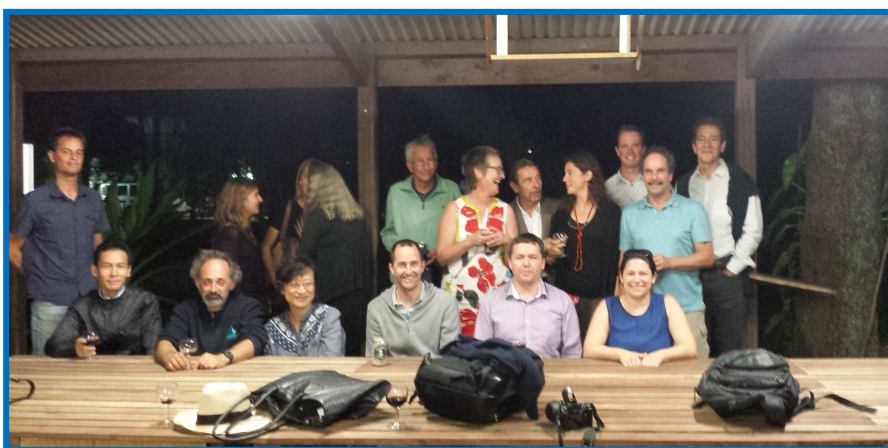


Figure 2: Face-to-face meeting at IRD centre in Nouméa, September 2015

Appendix: Agenda of the face to face meeting in Nouméa, 16-18 Sept. 2015

Day 1: Wednesday Sep 16, 2015

0800	Set up web connections	Local organizers/Upchurch
0815	Welcome from hosts; local arrangements and introductions	IRD lab director/SC
0830	Goals of the meeting and expected outcomes Review the BB TT TOR	Cravatte/Wijffels
0900	Update from SC & feedback from ENSO workshops (30)	Kessler
0930	Discussion of goals/agenda/SC guidance	All
1000	Breakfast/coffee/tea	
1030	Update from Planetary Boundary Layer TT	Cronin (430PM Seattle)/Farrar (730PM WH)
1100	Improving surface flux estimation – role of broadscale buoy observations	Yu and Lee
1130	Discussion of PBL issues/challenges	All
1200	Lunch	
1300	The 2015 ENSO	Shayne McGregor
1330	Costing the observing system elements (incl. discussion)	Lead by Roemmich
1400	Western Pacific updates: TRITON, LLWBCs, and ITF: status and plans, and discussion	Ando/Sprintall
1430	Science Talk 1 (30): "The role of Westerly Wind Bursts in the possible development of an El Nino in 2014"	Menkes
1500	Coffee/tea break	
1530	Update from the Eastern Boundary TT (15)	Ken Takahashi/BK
1545	Two subgroups break out to refine their Strawman plans (1 hours)	All
1645	Plenary – comments and discussion on entire day	
1700	End of Day 1	
1800	Welcome cocktails with IRD and PACENET staff	All+ other institutions and government delegates

Day 2: Thursday Sep 17, 2015

Provocateur: Kessler

0800	Arrival and set up	Upchurch
0815	Feedback from absent TT members Recap of previous day (Susan and Sophie)	Upchurch
0900	Presentation of Strawman 1	Team 1 (Wijffels)
0930	Discussion of Strawman 1	all
1000	Breakfast/coffee/tea	
1030	Presentation of Strawman 2	Team 2 (Cravatte)
1100	Discussion of Strawman 2	all
1200	Lunch	
1300	Workshop towards a single strawman	all
	<ol style="list-style-type: none"> 1. common elements 2. differences 3. start on priorities 	

	4. integrating all pieces of the observing system	
1500	Tea/coffee break	
1530	Science Talk: "Sea-level observations in the tropical Pacific ; existing and prospective observing networks"	Jerome Aucan, IRD
1600	Discussion on possible pilot observing activities	all
1630	Summary of discussion and unresolved issues	Kessler
1700	End of Day 2	
1930	Dinner at Chef's School	

Day 3: Friday Sep 19, 2015

Provocateur: Roemmich

0800	Arrival/setup	Upchurch
0815	Review feedback from absent TT members Recap of day 2 (Susan and Sophie)	Upchurch
0900	Science Talk: "Sea-level observations in the tropical Pacific ; existing and prospective observing networks"	Jerome Aucan, IRD
0930	Discussion: Possible Pilots	everyone
1000	Breakfast/Tea/coffee break	
1030	PI-GOOS, link between TPOS and the Pacific Islands (20 min talk/10 mins discussion)	Moore
1100	Strawman: Continue prioritizing elements and refining justifications Identify knowledge gaps and unknowns to be provided from other TTs and SCs. Discuss a low risk transition via pilots or other tests.	all
1200	Lunch	
1300	Developing a plan for review, refinement: 1. Sampling assessment tools – ARMOR3D, Gasparin OI, other? 2. Soliciting feedback from the GODAE Oceanview (Smith to present for TPOS) 3. Review by coupled prediction teams: how?	
1500	Tea/coffee break	
1530	Summary of discussion and unresolved issues	Roemmich
1600	Writing tasks and actions Plans to report to SC. Review of the TT ToRs. Membership discussion Next steps	all
1700	End of Day 3	

Social-Ecological Modelling of Innovative Genetic Control Approaches to Mosquito-borne Diseases

Grant team: Institut Louis Malardé-ILM (French Polynesia); Univ. of French Polynesia (French Polynesia); OXITEC (French Polynesia); Univ. of Oxford (UK); CIRAD (France); AVIA-GIS (Belgium); ETH Zurich (Switzerland); CNRS (France); Univ. of Melbourne (Germany); International Atomic Energy Agency (UN in Vienna, Austria)



PACE-NET Plus seed-funded workshop on

**“Social-Ecological Modelling of Innovative Genetic Control Approaches to Mosquito-borne Diseases”,
 at the Univ. of Berkeley-California, R. Gump South Pacific Research Station, Moorea, 1-5 Feb 2016**

Meeting summary

A workshop organized by Institut Louis Malardé (ILM) was held from February 1-5, 2016 at University of California’s Richard Gump South Pacific Research Station on the island of Moorea. The workshop, supported in part by the Pacific-Europe Network for Science, Technology and Innovation (PACE-NET Plus) was designed to deepen existing collaborations between labs in France, French Polynesia, Switzerland, the United Kingdom and the United States while bringing in additional European (Belgium, Austria) and Pacific (Australia) partners to tackle the major societal challenge of emerging vector-borne diseases. This workshop is part of an emerging international collaboration- “IDEA Consortium”- that involves institutions from both regions to develop the Pacific Islands, particularly French Polynesia, as a model system for sustainability science. It takes advantage of the opportunities provided through breakthroughs in molecular and evolutionary biology and a new generation of genetic technologies for insect control. Applying these new technologies effectively and safely, however, requires government oversight and evaluation (cost-benefit and risk analysis). The workshop stimulated cooperation among researchers and institutions in Europe and the Pacific on mosquito-borne infectious diseases, an issue that requires international coordination and scientific knowledge to improve the health and well-being of communities. The meeting addressed critical information gaps that hinder our ability to

efficiently control mosquito vectors and the spread of mosquito-borne infectious diseases. Meeting participants identified research priorities critical to the advancement of sustainable strategies to combat mosquito-borne infectious diseases and developed collaborative research projects on priorities identified in the Pacific.

Background

Social-ecological modelling of mosquito-borne diseases

The rapid emergence and expansion of Zika and other arboviruses (*e.g.*, dengue, chikungunya) in the last decade have become public health concerns of international magnitude. The situation is currently critical in Latin America and in several European overseas territories and island countries in the Caribbean and the Pacific. Two species of mosquito: *Aedes aegypti* and, to a lesser extent, *Ae. albopictus* have been linked with most known arbovirus outbreaks but the ecology of transmission in the Pacific may prove uniquely diverse. In addition to the above vectors, the native species *Ae. Hensilli* and *Ae. polynesiensis* have been implicated in outbreaks in Yap and French Polynesia. *Ae. polynesiensis* has a Pacific-wide distribution (French Polynesia, Wallis and Futuna, Fiji, Samoa, American Samoa, Tuvalu, Tokelau, Cook Islands, Kiribati, Pitcairn) while *Ae. hensilli* has an uncertain distribution that includes The Federated States of Micronesia and Palau. Overall, no less than 12 potential dengue vectors have been identified in the Pacific region. This diversity of mosquitoes and environments makes it the ideal site to study the diverse risks of transmission associated with different virus/mosquito populations and the environments that they inhabit. Collection of such critical knowledge would allow making informed preparations for outbreak control, target existing vector control interventions and most importantly evaluate new ones.

Innovative genetic control approaches

Over the past 10 years, substantial progress has been made in developing alternative, non-insecticidal, “genetic control” strategies for mosquitoes (McGraw, 2013). Genetic control includes three main approaches (1) classical SIT using ionizing radiation, 2) biocontrol methods that utilize endosymbiotic bacteria (*Wolbachia*) and (3) various methods that genetically modify the vector species (*e.g.* RIDL™, gene drive). These techniques are designed to reduce mosquito abundance and/or prevent the transmission of pathogens by the mosquito. Neither approach has yet been fully evaluated regarding their general applicability or long term sustainability. Implementation of novel tools, including with the existing arsenal will require adaptation and validation of selected strategy combinations to the local context. The use of novel technologies in the field also raises challenges on regulation and community authorization. Programs involving emerging technologies will need to engage stakeholders and develop credible methods to gain community acceptance if they are to be successfully deployed at a large scale.

Meeting outcomes

Meeting participants were able to:

- ◆ Identify a set of research priorities critical to the advancement of sustainable strategies to combat mosquito-borne infectious diseases
- ◆ Develop an integrated program of collaborative research on priorities identified in the Pacific

The proposed program consists in three collaborative, ‘use inspired’ projects (see description below) formulated to advance operational research in vector surveillance and control in the Pacific context. For researchers, these projects will highlight data needs and help generate hypotheses. For SMEs, they will help them translate scientific discoveries and technological advances into products and services. For decision-makers, they will help assess costs, outcomes, and risks of innovative vector control approaches, thus accelerating the innovation cycle and the regulatory approval for pilot deployment under operational conditions. Three pilot islands were selected within the Society archipelago to conduct the proposed projects based on their increasing scales of complexity, from the flat and relatively small atoll of Tetiaroa to the larger and more populated volcanic islands of Moorea and Tahiti. These projects will provide useful case studies for more complex environments like coastal areas and cities (Davies et al, 2016).

MozziSIM (Moorea)

The Island Digital Ecosystem Avatar (IDEA) platform leverages supercomputing and advanced modelling techniques to build virtual ecosystems: replicate island “avatars” that enable *in silico* studies and generate useful forecasting capacity for policy makers. Building on this platform, the Mozzi SIM pilot project, which combines medical entomology, environmental and social-ecological sciences, applied mathematics and computational sciences, will aim to build data-driven models of mosquito disease vectors in space and time by focusing on Moorea, a populated Pacific island ecosystem as a tractable model. The project will identify the factors promoting disease transmission and develop advanced computational simulations of policy-driven scenarios to test the relative efficacy and sustainability of different genetic mosquito control interventions (transmission blocking, and classical, transgenic, or biological Sterile Insect Technique). This modelling approach, which is of general significance for vector control programs, will greatly improve forecasts of vector-borne disease outbreaks at scales appropriate to management actions. The results will help improve public health outcome, ensure environmental protection, and address socio-economic concerns. Moorea, the 2nd most populated island of French Polynesia, is a volcanic island northwest of Tahiti. In terms of its biodiversity, Moorea is probably the best-known tropical ecosystem in the world. It is a natural laboratory spanning marine and terrestrial environments (that is constrained enough to be tractable, but sufficiently large (132sq.Km) to contain all the elements of a complex socio-ecosystem, including a sizable human population(~17,000).

MozziFREE (Tetiaroa)

ILM is currently conducting a pilot suppression trial targeting *Aedes polynesiensis* on the atoll of Tetiaroa. The technology relies on the symbiotic *Wolbachia* bacterium as a novel biocontrol approach (Bourtzis et al, 2015). *Wolbachia* is a natural bacterium and is not genetically modified. This approach to mosquito control is species-specific and safe for humans and the environment. With no offspring to sustain the species, the mosquito population eventually collapses. Ongoing work by ILM shows that releases of sterilizing males during the peak mosquito (rainy) season can efficiently and drastically suppress the targeted *Ae. polynesiensis* population. The MozziFREE project will expand releases to the entire atoll of Tetiaroa to assess the potential for mosquito elimination at an island scale. To achieve this goal, the project will explore cross-cutting technologies including the use of

drones to conduct aerial releases of male mosquitoes over large areas that are hard to access from the ground.

MozziBLOCK (Tahiti)

Dengue, Chikungunya and Zika viruses are all transmitted primarily by the mosquito *Aedes aegypti* in urban areas of the Pacific and worldwide. Novel control strategies to prevent transmission of these diseases are desperately needed. *Wolbachia* are bacteria found in many insects that can spread to high frequency, and certain strains have been shown to efficiently block the transmission of mosquito-borne viruses such as dengue and chikungunya. Introduction of *Wolbachia* into a target vector population has now been conducted successfully in a number of countries, including Australia, Vietnam and Indonesia; after introduction the *Wolbachia* remains at high frequency at release sites several years after the program was completed (without further releases) and continues to block virus transmission. The aim of the Mozzi BLOCK project is to conduct mosquito mass-rearing & releases into sites of Tahiti targeting *Ae. aegypti* to take virus transmission-blocking *Wolbachia* to stable high population frequency; then once the feasibility of the strategy in these initial sites has been demonstrated, expand towards an island-wide replacement program through a community-based approach.

Contribution to PACE-NET Plus project goals

The workshop addressed the PACE-NET Plus focal areas, especially two of the major societal challenges identified in Horizon 2020: 1) health, demographic change and wellbeing; and 2) climate action, resources use and efficiency, and raw materials. The meeting helped twin the labs of the lead participants as part of the broader IDEA Consortium, which already involves 20 institutional nodes. The meeting also deepened collaboration among existing European-Pacific nodes and expanded to add new nodes from the two regions, including the first in Australia. It promoted joint actions of the EU and its Member States with respect to the Pacific through bi- regional research cooperation in Science (social science, ecology, environmental science, modelling, and computer science), Technology (genetic control methods, scenario based planning software) and Innovation (public and private sector engagement in the evaluation and implementation of new insect control approaches).

Potential to attract further funding, potential for further collaboration, and/or potential for generating innovation

Capacity building, and strategy for technology transfer

Implementation of the proposed IDEA projects will require significant local building of capacity in operational research. To this end, the government of French Polynesia recently pledged to modernize and expand the ILM mosquito research facility in Tahiti with the construction of an experimental module for mass-production and release of (*Wolbachia*) mosquitoes.

The proposed projects hold great potential for seeding much larger programs and accelerating the EU-Pacific innovation cycle to solve pressing environmental and health challenges. The projects will enhance and expand an emerging EU-Pacific bi-regional collaboration that takes advantage of the unique opportunities presented in the Pacific

Islands as model systems for a holistic integrated approach to some of the most significant societal challenges facing both regions. The IDEA Consortium and the proposed “Mozzi” projects fit very well within EU Horizon 2020 as well as Biodiversa ERAnet, PACE-NET+ and the priorities of national funding agencies. Moreover, the projects will generate a body of knowledge and operational tools of particular interest to the United Nations in their efforts a) to improve knowledge of disease-transmitting mosquitoes and b) to promote field trials to test the feasibility and operational efficacy of area- wide, integrated mosquito vector management interventions including the Sterile Insect Technique. Funds will be sought through EU (Horizon 2020), regional (SPC) and international agencies (WHO,IAEA) to support the proposed projects, foster technical cooperation and later assist with the carefully planned pilot deployment under operational conditions of these innovative surveillance and control tools in the Pacific and European regions.

Land snails as pest agents of decline of self-sufficiency in healthy food production and potential for utilizing edible native snails

Grant team: The University of the South Pacific (Reg.); Technical Centre for Agricultural and Rural Cooperation-CTA (EU); Land Care Research-LCR (New Zealand); Institut Agronomique de Nouvelle Calédonie-IAC (New Caledonia)

Introduction & Background

There has been a substantial shift in how Pacific Island communities acquire food. A decline in traditional crop use and non-traditional cropping systems has been recorded and this includes a shift towards foods that are not always cooked e.g. English cabbage, lettuce. Not only have new crop species and cropping systems been introduced-but this has been followed by the establishment of a suite of introduced **non-native** herbivorous insects and snails, and plant pathogens due to expanding trade. Non-native land snails are recognized internationally as one of the most important, non-host-specific crop pests. Non-native, herbivorous terrestrial molluscs (=land snails) are widespread in the Pacific Islands. Out of Asia *Angiostrongylus cantonensis*, the rat lung worm has now become widely distributed in Melanesia. The parasite is known to be vectored by non-native snails which in turn contaminate fresh vegetables and fruits potentially exposing people to the risk of *eosinophilic meningitis*. The risk is considered higher when foods are uncooked. At least two independent Fiji government sources have expressed anecdotally that Fiji has an unexplained high rate of meningitis but data to support this appears to be inadequate to date largely because of the nature of recording mechanisms which either do not record or do not differentiate between different forms of meningitis. Native terrestrial molluscs of genus *Placostylus* have been harvested for human consumption in the wild in New Caledonia for several years and pilot studies on commercial farming have occurred. These native snails (Fig. 1) are highly valued by the local indigenous people as a traditional food source and they are also used for medicinal, handicraft and ceremonial purposes. Despite their high protein value, and the fact that twice the number of endemic species are recorded in Fiji than in New Caledonia, there is to date no recorded of *Placostylus* and snails ever being consumed by humans in Fiji. Their conservation however, is of considerable interest to the local NGO Nature Fiji/Mareqeti Viti. It is uncertain if the rat lung worm *Angiostrongylus cantonensis* is also present in native snails but if found, this would undermine the sustainability of native land snails as a traditional source of food. Our project recognized that the loss of traditional crop diversity and increasing introduced species impacts to crop production is threatening food security in the Pacific. There is a need to be innovative but also to build on the evidence base, raise awareness and improve policy responsiveness to the pressures, including an understanding of the potential for associated health risks to humans.



Fig 1.: Shell of an endemic *Placostylus* snail native to New Caledonia

Project Activities Undertaken and their Outcomes

Activity Undertaken	Outcome
1. Face to face meeting of project leader (Brodie) with EU partner (Francis) during regional workshop the role of University's in food security.	Respectful relationship established which made later remote contact easier (See Fig.2)
2. Meeting of Oceania based project team & Stakeholders in New Caledonia	Enhanced understanding of not only the similarities but the strong differences in terrestrial mollusc perspectives established. New respectful relationships established which made later remote contact easier (see Fig. 3)
3. Meeting with Fijian Government Departments & relevant local NGO	Willingness of all identified stakeholders to participant in future collaborative activities confirmed, particularly Ministry of Health and Biosecurity Authority that have requested MOU's (see Fig. 4)
4. Meeting with New Caledonian Government Departments & local NGO	Willingness of all identified stakeholders to participant in future collaborative activities confirmed, particularly Pasteur Institute research unit of local hospital in Noumea.
5. Visits to local fresh food markets	Confirmation of relatively "new" introduced foods for sale that are often uncooked (see Figure 5)
6. Visit to field sites with endangered native snails and introduced pest snails present	Comparison of native <i>Placostylus</i> snail habitat types, species and size made between Fiji and New Caledonia (see Fig. 6)

7. Draft land snail and <i>Angiostrongylus</i> sampling protocols	Contacts established with Ministry of Health, Biosecurity Authority of Fiji and Ministry of Agriculture in Fiji. Theoretically possible and common intermediate host land snail species in Fiji and New Caledonia determined. Yet to establish molecular methods for detection of <i>Angiostrongylus</i> in land snails
8. Determine knowledge gaps for undertaking a formal risk assessment of invasive species in line with regional bio-security regulations and protocols	Contacts established with Ministry of Health, Biosecurity Authority of Fiji and Ministry of Agriculture in Fiji. Knowledge gaps on intermediate and paratenic hosts of <i>Angiostrongylus</i> determined. Data lacking on prevalence of <i>Angiostrongylus</i> in hosts from the field
9. Draft framework for human health and environmental risk analyses	Contacts established with Ministry of Health, Biosecurity Authority of Fiji and Ministry of Agriculture in Fiji. Draft questionnaires formulated together data from medical practitioners and general public. Risk analysis conceptualised pending gathering of data and simulation of scenarios using risk assessment models
10. Meeting of project team in Fiji	Comprehensive framework for future program of collaborative research established and discussed. Framework has four distinct focal areas
11. Draft outline of a larger research proposal	Established that requirements for much larger research proposal (to followed developed program framework) will require further investigation and relationship building particularly within Europe. However, three smaller proposals have already submitted to acquire funds to support future collaboration with stakeholders

Links to PACENET–Plus Seed Funding Objectives

Our project has contributed significantly to the PACE-NET Plus goal of enhancing collaboration. We have not only created new hopefully long-term research partnerships but have also significantly expanded our research collaboration to include support to, and cooperation with, civic society and therefore potential initiatives for policy change via cooperative dialogue. In addition to this our project has initiated innovative research in the areas of (1) molecular tool use, and associated development of a stand cost effective identification of disease causing parasites; (2) risk management analysis to aid priority setting and (3) documentation and exploration of traditional knowledge in native terrestrial mollusc use.

Photographs



Fig. 2. Project Team member Judith Francis (2nd from left) with USP research office staff, and regional colleagues, in Nadi, Fiji in June 2015 as the current project was just starting.



Fig. 3. Project Team members at Institut Agronomique de Nouvelle-Calédonie (IAC), New Caledonia



Fig. 4. Meeting of project team members with government(ministry of health, ministry of agriculture, Biosecurity authority) and NGO stakeholders(Nature Fiji) in Fiji July 2016



Fig. 5. Photographs of several crop species being sold in main food market in Noumea –Dec2015

Note: English cabbage and lettuce, which are often consumed without cooking

Deviations compared to planned proposal

The late arrival of the PACE-NET Plus call funding decisions, and then the slow process of getting a project contract signed, and then accessing a vote code resulted in non-inclusion of all project members in all activities as originally proposed. Dr. Singh (USP Samoa) for example was not logistically able to make the trip to New Caledonia at the end of 2015 and it was also difficult to formally invite our IAC members to stakeholder meetings in Suva because of uncertainty with costs and rescheduling needed when unexpectedly the Fiji government had to focus all its staff time to cyclone Winston disaster management. This particularly impacted government staff in the health and agriculture sectors where we were working. This uncertainty did not give us enough time to have a proper full meeting of all team members in Suva at the end of the project. We did however successfully conduct all scheduled meetings in the original proposal to the best of our ability, and to finish in time merged the final team meeting (with a reduced team) with a collective Fiji government stakeholder meeting. To further overcome these issues we have already applied for funding from a different source to send Dr. Singh to Noumea to meet with medical research practitioners and Dr. Brescia from IAC will come to Fiji to represent our team in the final meeting in Nadi. With more time we could have funded at least one of those activities from our project budget which still has remaining funds.



Initiating a Science, Technology and Innovation Policy Development Process in the Kingdom of Tonga

Grant team: Dr Katherine Daniell, The Australia National University; Hon. Siaso Sovaleni, Deputy Prime Minister, Kingdom of Tonga; and Mr Taaniela Kula, Deputy Secretary, Ministry of Lands, Survey and Natural Resources; and, Dr Gerd Ruecker, Policy Advisor, DLR – Project Management Agency (DLR-PT)

Summary

Following discussions at the Auckland PACE-NET Plus Think-Tank, this seed-funding project sought to capitalize on the willingness of Tongan policy makers to initiate a science, technology and innovation (ST&I) policy development process in their Kingdom. The project—coordinated by the Australian National University, DLR Project Management Agency and the Ministry of Lands and Natural Resources of the Government of Tonga—commenced with a review of the current state of legislation and policies related to science, technology and innovation. It was found that these themes, especially the importance of research underpinning decision-making across policy areas, were already effectively embedded in existing policy documents, including the central ‘Tonga Strategic Development Framework 2015-2025’. However, the lack of a national ST&I policy meant that a range of key ST&I opportunities and challenges in meeting the objectives of this framework are likely to remain largely unaddressed. The next stage involved a scoping mission to Tonga by the ANU, where a range of ST&I policy stakeholders were interviewed in order to determine their ST&I needs, their perspectives on whether and how an ST&I policy framework would be useful, as well as the philosophy on which this framework should be based. At the same time, DLR undertook a review of other countries’ ST&I policy frameworks and systems in order to provide external ideas on what has (or has not) worked. The results of this stage then fed into the third stage of the project, a 1.5 day ST&I policy development and knowledge exchange workshop, held on 23-24 June 2016 in Nuku’alofa, Tonga. The workshop was opened by the Deputy Prime Minister, The Honourable Siaso Sovaleni, which demonstrated the high-level political support of the process. The results of the interactive workshop, along with the initial scoping results, then informed the writing of the draft ST&I policy framework, the summary of which was presented to the PACE-NET Plus platform attendees in Fiji on June 31. The draft policy is now being finalized by the Tongan Government and will then be submitted to cabinet.

Seed funding grant was administered by:

**The Association
of Commonwealth
Universities**



**Tonga Science, Technology & Innovation Policy Framework Scoping Workshop
 23-24 June 2016, Davina House, Vuna Road, Tonga**

Rationale and Background

Science, Technology and Innovation (ST&I) underpin development and provide the basis for addressing many societal challenges. In the Pacific, these are particularly those associated with the management and use of land, agricultural, marine and freshwater resources under changing climates and economies. The 2014 Framework for Pacific Regionalism, which replaces the 2005 Pacific Plan, has as its first principal objective “Sustainable development that combines economic social, and cultural development in ways that improve livelihoods and well-being and use the environment sustainably.” Despite the fundamental importance of ST&I to development and management of the environment, there is almost a complete absence of national ST&I policies in Pacific Island Countries (PICs). The Kingdom of Tonga has a very long and proud history of public education, with a more recent emphasis on ST&I training. The vision of the Tonga Strategic Development Framework 2015-2025 is to achieve a high standard of living and quality of life for all Tongans, and also to ensure that development is economically, environmentally, culturally and politically sustainable. This document recognizes the value of science already in ‘Organizational Outcome 4.5’, providing an excellent basis for specific policy development. However, the absence of a national ST&I policy currently means that key ST&I opportunities and challenges in meeting this vision are likely to remain largely unaddressed. It also means that existing ST&I actions often do not integrate education, science, technology and innovation aspects, but rather remain separate, fragmented and unsustainable in the medium to long-term. Such an absence of ST&I policy also constrains regional and international cooperation with European, Australian and New Zealand researchers and SMEs and funding from respective bodies. This work has thus aimed to initiate and explore the potential for a ST&I policy development process in the Kingdom of Tonga. It is hoped that it may be seen as a pilot example for other Pacific Island Countries to enhance ST&I policy development across the Pacific Region.

Process

The initiation of the ST&I policy framework for the Kingdom of Tonga under this seed-funding project was developed firstly through 1) teleconference meetings, legislature and ST&I system reviews, and 2) a scoping mission to Tonga where 19 interviews with a wide range of heads and key staff of ST&I relevant ministry agencies and industries were undertaken. This allowed initial key ST&I priorities and currently existing ST&I- relevant initiatives to be identified, the philosophy and principles of the ST&I policy framework development process to be set, and important ground work to be undertaken in order to design an appropriate next stage. In particular, the agreed prime philosophy was that the Policy Framework must be developed by Tongans for the benefit of Tonga. It was also particularly important that the ST&I Policy Framework be consistent with: 1) The Tonga Strategic Development Framework 2015-2025; 2) Existing policies, strategies and plans, particularly those on environment, natural resources, energy and climate; and international and regional initiatives & agreements. As part of the scoping studies, interviews confirmed that the ST&I Policy Framework must focus on gaps in Tonga-relevant knowledge, rather than repeat overseas work. It should also include traditional science and knowledge, and involve youth, as they are the future of Tonga. More specifically, the strategic ST&I framework must have an implementation plan, key performance indicators, and monitoring and evaluation framework. A range of issues in the ST&I system of Tonga were also raised in this phase including that: ST&I education in schools and technical colleges needs to be improved; coordination in ST&I in Tonga needs to be improved; access to ST&I information is inadequate; there is a lack of analytical and product testing facilities making, for example, food safety and security difficult to guarantee. One solution of the need for a Tongan National Research Centre to address many of these issues was also raised.

The second phase was a 1.5 day workshop on Science, Technology & Innovation (ST&I) Policy Framework development on 23-24 June 2016 in Nuku'alofa, Tonga. The workshop was officially opened by the Deputy Prime Minister, Hon. Siaosi Sovaleni and brought together 34 participants from ST&I-related Agencies, Technology Institutes and Organizations. These participants consisted of the key staff at the operational level of these organisations. The first part of the workshop considered how other countries have approached ST&I policy and which good practices of STI policy could be used to enrich the Tonga ST&I policy. Together with the outline of the key points from the interview phase, it provided a basis upon which ideas in the workshop could be developed. The second phase was highly interactive and involved all participants contributing to analysing: Tongan values and ST&I priorities and objectives; existing ST&I strengths and structures (*e.g.* infrastructure, policies, institutions, human resources); ST&I gaps and challenges; ST&I opportunities and strategies to achieve the policy objectives, including identification of champions to lead and resources required to implement them.



In the last phase of the workshop, some of the key sections of the policy framework were also workshopped based on participants' contributions from both the interview and workshop phase including the vision statement, overall goal and strategies for achieving these and key ST&I policy structure items.

Outcomes

The planned outcomes of the project for initiating the ST&I policy development process in Tonga were achieved through this process, including:

1. The first inter-ministerial ST&I meeting in Tonga was held
2. The Tongan participants, including the Deputy Prime Minister fully supported, and were actively involved in the policy development process.
3. A structure of an ST&I policy framework was identified that covers the area of legal frameworks; good governance; knowledge sharing; research infrastructure; advanced education and training; and entrepreneurship, creativity and innovation.
4. A range of policy strategies were affirmed including the development of: a Tongan National Research Centre; a ST&I Council or task force for governance and guidance; a Centre for Innovation to support business development; ST&I talent identification both locally and globally and a network to support local ST&I initiatives and implementation; improved international marketing through certified quality products; adequate laboratory equipment that enable critical tests and experiments locally; enhanced data and knowledge sharing; closer collaboration between ST&I relevant agencies; and incentives for ST&I.
5. Developing understanding of ST&I Policies and good ST&I practices in other countries.
6. A draft broad vision, goals and statement was endorsed by the working group.
7. Identification of potential opportunities for further funding of the ST&I implementation activities.

Lessons Learnt and experiences gained

We learnt that this project was a 'dream come true' for many Tongans. Tonga already has a long ST&I system experience and many of the people who we met have had plans in their minds for improving research and its links to decision-making in Tonga for many years. It was also evident that there are many ST&I initiatives and talents that exist in Tonga but

many are currently hidden by limited roles in the workplace, employment sector, a culture of humbleness and a lack of opportunity for exposure.

The Tongans who have so far been involved in the process thus relished the experience of sharing knowledge about ST&I systems, achievements and experience among sectors. They have seen the importance of this knowledge sharing, including with the public at large through the media and how it can encourage ST&I collaboration in Tonga.

Of vital importance to the success of the process was also finding the right Tongan champions for the development of the ST&I framework. Having both a high-level Government project partner and his team to support the on ground work in Tonga, as well as the visible high-level political-level support of the Deputy Prime Minister, meant that the project had the capacity to meet its objectives. International contribution and shared facilitation can speed up the ST&I Policy development process. Maintenance of this enabling political and structural support environment, as well as further and internal and external resources will be necessary to drive and implement the ST&I Policy in Tonga and have its benefits seen at the regional and global level.



The Opening Ceremony: (from right to left) Dr Gerd Ruecker, Policy Advisor, DLR – Project Management Agency (DLR-PT); Dr Katherine Daniell, The Australia National University; Hon. Siaso Sovaleni, Deputy Prime Minister, Kingdom of Tonga; and Mr Taaniela Kula, Deputy Secretary, Ministry of Lands, Survey and Natural Resources.

PACE-NET Plus Project Consortium

