Consolidated Responses to PAFPNet Discussion Query on

'Climate Change Adaptation and the Role of Agriculture'

INTRODUCTION

The "Climate Change Adaptation and the Role of Agriculture" discussion query ran from 27/3-13/4/18 to assist in collating Pacific viewpoints for contribution to the Subsidiary Body for Scientific and Technological Advice (SBSTA) Forty-eighth session Bonn, Germany, 30 April to 10 May 2018 in relation to Item 8: "Koronivia joint work on agriculture". This will guide work to address vulnerabilities of agriculture to climate change and approaches to addressing food security. The Koronivia joint work on Agriculture (KJW) came out of the Bonn COP23 meeting and focusses on 6 statements.

In this PAFPNet Discussion Query, we asked the following questions which related to parts of the KJW document:
A1. Describe approaches that would work best for your country to embed practices of agricultural, forestry and land-use adaptation to climate change in the Pacific?
B1. What sources of information could be used to measure adaptive changes in agricultural systems (including co-benefits and improved community resilience)?
C1. What are the greatest risks to good soil management and describe the most successful soil conservation processes that you are aware of in your country?
D1. *Suggest ways that soil biological activity and soil health can be improved, based on your national experience.*
E1. What options do you see for improving integrated crop and livestock production systems to ensure efficient use of nutrients, livestock waste and protection of soils, and what needs to change?
F1. Suggest three changes to increase agricultural resilience in the Pacific?

SUMMARY

There were 12 submissions or detailed comments which came from PAFPNet members in Fiji, Cook Islands, Solomon Islands, Kiribati, Thailand, New Zealand and Australia.

A. Implementation

Respondents made suggestions for continued development and re-training of extension officers and progressive approaches in agricultural research and training institutions. There was a recognition of the benefits of model farms where farmers could go to see new land-use approaches in action, and a call for incentives for farmers practising conservation farming approaches that build soil carbon, soil water storage and maintain nutrients. Farmers need long-term access to land through kastom or leasing arrangements, so that they have the motivation to increase soil fertility.

B. Assessing adaptation and resilience

A call was made for better modelling and decision support tools to improve crop modelling and long term sustainability. These tools need to be able to model integrated livestock-forestry-cropping systems. 'Livestock' should include aquaculture systems as well as cattle, sheep, pigs, goats and poultry.

Improvements in adaptation need to consider the success of changes in adverse conditions, such as drought, not just improvements in better seasons.
There was also recognition that measurement is scale-dependent, from field and farm up to river catchments and whole islands.

C. Improved soil health and soil fertility

The most significant risks to good soil management were farmers not having long-term motivation to maintain soils, and loss of knowledge and incentives to operate more complex, traditional integrated systems of agroforestry, with or without livestock.
One suggestion also included re-considering terracing as a soil conservation option, where farmers were moving onto steep land, but this could also include more contour farming even on flatter land.

D. Improved nutrient management

Suggestions were made for giving government incentives to farmers who were increasing the biological activity of their soils, who were farming with nitrogen-fixing systems and cover crops, and increased use of integrated tree-cropping systems to assist in soil stabilisation and circulation of nutrients from deeper in the soil profile.

E. Improved livestock systems

Suggestions included continuing basic work to improve herd health and breeding, increased use of leguminous crops (including trees) and improving the use of rotational grazing to increase plant recovery times. Healthy livestock populations may need cooler conditions, such as thatched-roof shedding and lower stocking numbers. Feedstocks to maintain animals in a healthy condition all year round requires further work on local and imported options. Integrated agroforestry-livestock systems can contribute to nutrient cycling and the management of weeds too.

F. Increasing agricultural resilience

A major theme here was the importance of continuing national and local plant and animal breeding efforts. Particularly for some Pacific staple crops there was a recognition of the narrow genetic diversity and the importance of constantly renewing that through systems of sharing materials.
A second theme was the importance of continuing to research and support integrated agricultural systems which provide the resilience of trees, crops and livestock.
Landscape scale issues raised included the need for avoiding making land more fire-prone (and the increasing risk of this with longer dry seasons), the importance of trees in the landscape for clean water and soil stabilisation and the use of terracing as a mechanism to stabilise agricultural land.

RESPONSES

Responses were received from:

1. Dr Geoff Smith, researcher, UNE Australia
2. Peter Kjaer, farmer, Fiji
3. Dr Grahame Jackson, researcher
4. Dr Lex Thomson, researcher,
5. Moses Pelomo, Solomon Islands Kastom Garden Association

6. Souad Boudjelas, Pacific Invasives Initiative, University of Auckland
7. Andrew Tukana, Land Resources Division, SPC
8. Prof. Peter Edwards, Asian Institute of Technology, Thailand
9. Marau, Kiribati
10. Lydia Sijp, Cook Islands
11. Viliamu Iese, USP Fiji
12. Don Miller

The responses are presented in chronological order.

1. Submission from Dr Geoff Smith, UNE (29/3/18):

General comments:

I haven't done much on resilence or adaptation as we need to focus on solving on–farm issues before approaching the wider issues e.g. we were proposing to try and model the greenhouse gas consequences of any improved productivity – but as a desktop exercise. See comments below.

The economics of forestry/agroforestry systems are relevant. That is, I see a lot of these issues to do with land ownership and any forestry type investment needs solutions that work within Pacific settings. Most importantly it seems we need long term financial arrangements to assist with long term forestry investments that are culturally acceptable and relevant to Pacific land ownership and land use.

C1. What are the greatest risks to good soil management and describe the most successful soil conservation processes that you are aware of in your country?

From my observation, over-grazing and burning seem to be the big issues in drier areas of Pacific island countries.

E1. What options do you see for improving integrated crop and livestock production systems to ensure efficient use of nutrients, livestock waste and protection of soils, and what needs to change?

There has been good progress in poultry but small ruminants are very early days. Work is needed on basic herd health, which will contribute to more efficient production systems. For small ruminants, there are opportunities for improved efficiency through addressing parasite management and the dry season feed gap. There are only small areas of improved pastures and there seems to be considerable overstocking. Different combinations of crops/feeds might assist in improving livestock production in an integrated system (and these may be location-specific) but it seems cut and carry systems probably wouldn't work. Labour shortage and the non-centralised layout of most farming communities would maybe work against it. There are examples of intensively managed farms and these systems will be assessed. Tree legumes offer some possibility for the dry season – although see comments about cut and carry.

2. Submission from Peter Kjaer, Taveuni. Fiji, Farmer & member of TeiTei Taveuni (4/4/18)

We are growing pineapples and rehabilitating 250 ha of coconut plantation and will produce virgin coconut oil at the end of the year.

A. Modalities (ways, methods, partnerships) for implementation of further work on agricultural adaptation in the Pacific?

A1. Describe approaches that would work best for your country to embed practices of agricultural, forestry and land-use adaptation to climate change in the Pacific?

Where are we? As for now very little is being done. Some research results are available – for example a 5 year successful Soil Health Project ACIAR/SPC/MPI/TTT was completed on Taveuni/in Samoa/in Kiribati – but the findings are not being implemented/used by MPI. Long-term soil fertility needs to be prioritised over short term productivity.

Where do we want to go? We need to prioritize long-term sustainability via rebuilding long term soil fertility

How do we get there? MPI has to work with NGO's like TeiTei Taveuni (TTT) and other organisations which prioritize sustainable farming practices. Rebuilding soil fertility cost money and transition to sustainable farming practices takes time and should be supported economically.

At the same time, research into sustainable farming practices should be funded, for example cover crops suitable for Fiji, and availability of cover crop seed.

FNU's Koronivia Campus should get additional funding to teach sustainable farming practices – if the next generation of farmers and extension officers continue to get conventional/chemical farming information/education nothing will change.

Funding for retraining of MPI officers in sustainable farming practices or carbon farming practices must take place if change is going to be implemented.

B. Methods and approaches for assessing adaptation, adaptation co-benefits and resilience?

B1. What sources of information could be used to measure adaptive changes in agricultural systems (including co-benefits and improved community resilience)?

Where are we? Extension services tend to promote "conventional chemical farming practices" and we have the SPREP project "Ecosystem based farming systems" and the ACIAR/SPC/MPI/TTT Soil Health Project somewhere in between. Very little/no coordination of a common direction.

Where do we want to go? We want to show farmers that their long term interest – if they own their land – is to use it in a sustainable manner. That it pays off to take care of the land long term.

How do we get there? Tei Tei Taveuni is currently try to develop 10 model farms using sustainable land management under EU/FAO's AAD program. The intention is to demonstrate that a diverse farm, farmed in a sustainable manner is viable. That it is possible to farm the same land sustainably as an opposite to the current system where a piece of land is exploited and then left as "old land" and the "farmer" moves to "new land" and possibly cutting down forest.

If we can get the model farms to perform we believe we can change farmers' perceptions.

C. Improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management?

C1. What are the greatest risks to good soil management and describe the most successful soil conservation processes that you are aware of in your country?

Where are we? Very few farmers are working with a "soil carbon perspective". The PICTs support is only in policy declarations.

We are in a situation where subsistence farmers are entering a semi commercial market – Taveuni's dalo production is a perfect case study – and the soils are being exploited as long as possible, then the cheapest conventional fertilizers are used to revive yields. It continue to the stage of collapse. The process is accelerated by heavy use of weed killers as Gramazone and Glyphosphate which diminish soil biology and thereby the chance of recovery.

The greatest risk is to continue "business as usual".

Where do we want to go? We have to change farmers and MPI's perspective to include carbon building practices.

How do we get there? Investing in substantial retraining of MPI staff – both research and extension staff.

Implement incentives for farmers actually rebuilding soil carbon.

Financial support for transition from conventional chemical farming to sustainable farming practices.

There are attempts on soil conservation practices ex including *Mucuna* as a green manure crop or improved fallow crop. Some farmers use TTT's fertilizers with low salt index. TTT recommend reducing use of glyphosphate to ½ by controlling pH in the spray mix if farmers insist on using it. Using of agricultural lime is slowly being adopted in parts of Fiji making it possible to reduce fertilizer applications due to more efficient use of the fertilizers applied.

D. **Improved nutrient use and manure management towards sustainable and resilient agricultural systems?**

D1. ***Suggest ways that soil biological activity and soil health can be improved, based on your national experience.***

Where are we? Not much attention is being given to soil biology. There is very little institutional knowledge within MPI if any in regards to the necessity of soil life. TTT did 7 modules of Soil Schools for Taveuni's farmers 2010-2012 and it was supported by the then PS and Minister of Agriculture. It was met with very little understanding from MPI's staff.

Where do we want to go? We need to develop agricultural practices which support soil biological activity under the Fiji conditions.

How do we get there? Funding for research into cover crops, crop rotations building soil carbon levels, intercropping systems building soil carbon.

Provide Koronivea RS with equipment for measuring soil carbon – not only organic matter – and provide extension with simple hands on equipment to measure soil carbon.

Making Biological farming part of FNU's Koronivia Campus curriculum.

Supporting farmers implementing biological farming practices

E. Improved livestock management systems?

E1. What options do you see for improving integrated crop and livestock production systems to ensure efficient use of nutrients, livestock waste and protection of soils, and what needs to change?

Where are we? As stated there are good livestock operations with pastures and grazing systems which favour carbon building. But the majority have overgrazed poor pastures low on nutrition resulting in low production.

Where do we want to go? We want to have livestock operations where pastures build carbon levels.

How do we get there? Affordable access to seed mixes which favour carbon building. Australian researchers state that a minimum of 8 species in a mix is required, but a mix with 30-40 species is better.

We need research into seed mixes which work under Fiji conditions.

We need support for fencing for making sufficient paddocks to manage rotational grazing.

We need research into livestock mixes which improve grazing and economic yield under Fijian conditions. Rotated herds of cattle, sheep etc is supposed to improve utilization of pasture.

Support for use agricultural lime. Tailevu's pastures infested with Navua Sedge is a prime example of soil depletion.

F. Socioeconomic and food security dimensions of climate change in the agricultural sector?

F1. Suggest three changes to increase agricultural resilience in the Pacific?

Where are we? Somewhere in a subsistence agricultural system where soils are being depleted because farmers commercially sell produce and reduce traditional recycling of nutrients. Lack of modern sustainable farming systems

Where do we want to go? To increase resilience we need to rebuild carbon levels in soils. Meaning carbon tied up as humus not only more organic matter/labile carbon

How do we get there? 1. Farming families must have long term users rights to the land they farm, making it worthwile to work on long term strategies 2. We must increase carbon levels in soils – farmers who build carbon should be prioritized in regards to support and farmers who run the land down should be without support. 3. Transition to carbon farming should be subsidized and farmers interested should sign up and be monitored. A 5-10 year plan should be developed with the farmer and as long as the farmer follows the plan and builds soil carbon the farmer should be supported.

3. Submission from Dr Grahame Jackson (7/7/18):

I would just like to say a few words in response to F1. I can't give three suggestions but I would like to give one. We need to increase the resilience of Pacific root and tuber crops to pests and diseases and much more. We know from extensive work that the genetic diversity of all the root and tuber crops is narrow. That means for any species the varieties are similar. They may look different but are otherwise the same, a bit like brothers and sisters. This makes them vulnerable to pests and diseases. Think taro leaf blight: all the varieties got the disease as they had the same DNA. How was taro leaf blight solved? By bringing taro from countries outside the region and breeding with them, crossing them with Pacific taro.

Are there other pests and diseases around or coming to the region? Yes. Cassava bacterial blight is now in the south Pacific, close to many countries where cassava is important; a citrus psyllid is present in some countries and this can spread a devastating disease; yams are getting severe dieback; sweet potato weevils and viruses abound and decrease yields; and returning to taro leaf blight, many countries have not got the tolerant varieties yet. We could go on. And climate change will make a bad situation worse.

What to do? Breeding is the answer. For taro it has been shown to work; we need to continue with taro and put breeding to work to improve the other staple food crops, and to find ways of working with farmers to evaluate the results, that is, participatory crop breeding. Help farmers by giving them varieties that are a mix of genes from other parts of the world and let farmers select what they like and what fits in a changing environment.

It's possible and exciting to do!

4. Comment from Dr Lex Thomson (10/4/18) PARDI2 Team Leader, University of the Sunshine Coast:

Vinaka Grahame your contribution and fully agreed with your observations and proposed solution.

Delighted to report that Dr Vincent Lebot (copied) in Vanuatu is taking the lead and doing excellent work on breeding more diverse and nutrient-dense root crops, and we need others in the Region to follow his example, including by giving our 'bare-foot' breeders and farmers diverse open-pollinated seed from which to make their own locally-adapted selections of kumala, cassava, taro etc.

5. Response from Moses Pelomo, Solomon Islands Kastom Garden Association (10/4/18):

Fully agreed with what Dr. Grahame Jackson said. This is also why we need to protect and conserve whatever diverse crop plants (root crops, greens, nuts and fruits) we have by collecting, bulking, testing and distributing them within the country and conducting breeding programs as suggested by Grahame.

6. Response from Souad Boudjelas, Pacific Invasives Initiative, University of Auckland (10/4/18):

One comment I'd like to make is that biosecurity and pest and disease management are missing. I believe that improved biosecurity and pest and disease management are essential for agricultural resilience in the region.

7. Submission from Andrew Tukana, SPC (11/4/18):

E1. What options do you see for improving integrated crop and livestock production systems to ensure efficient use of nutrients, livestock waste and protection of soils, and what needs to change?

Integrated livestock production systems are very important for small Island States where land is mostly limited, so there is a need to ensure that other resources such as feed ingredients and crop by-products can be used efficiently to maximise livestock production. Using locally available feed ingredients ensure that the cost of production is kept low and production is organic. Other factors such as basic husbandry practices will also be needed to assist with production and to counter climate change impacts, e.g. with increasing temperatures, stocking rates in chicken sheds need to be reduced to minimise mortality and improve growth rates, housing could be constructed using local bush materials, e.g. thatched roof which will make livestock houses cooler and enable farmers to be more resilient after disasters such as cyclones, i.e. they could easily go into the forest and bring materials to rebuild the roof of their livestock shed after a cyclone, etc. Agroforestry practises that rotate livestock pens over land, ensure integration between livestock and crops, by weed control and providing manure before crops can be planted.

With the increase in human population in PICs, more integrated livestock and crop production systems is needed to provide livelihoods, as well as food and nutritional security.

8. Comment from Emeritus Prof. Peter Edwards, Asian Institute of Technology (12/4/18):

Dear Andrew,
And perhaps integrated with fish too. You aggies invariably forget fish.

9. Submission from Marau from Kiribati (12/4/18)

Hi,

On the island where I am now, I feel sorry that not many varieties of taro and cassava are used, and not sure what varieties they are. So please include my island and my school when thinking about new varieties of taro and cassava. If possible could you send some tissue culture for my school on the island of Abemama, part of Kiribati in the central island of Kiribati.

I only know of two varieties here, known as Tarondana and a PNG variety so hope you agree with this case. This will help us be ready for disease and pest attack .

10. Comment from Lydia Sijp, project coordinator, Emergency Management, Cook Islands (13/4/18)

I would like to add to Marau's comments on varieties of Taro..

After the 2005 – five cyclones in the Cook Islands- Women from the Island of Pukapuka, who own and work their Taro Patches, noticed they had lost a number of varieties that was native to Pukapuka. We applied to FAO via the Ministry of Agriculture (MOA) for assistance to try and save what taro species they had left..and have them saved into the Taro Bank in Fiji, and to re-introduce some of the varieties from the southern group islands to replace the varieties, that had been lost. I am not sure of the outcome of that project, but maybe the region would benefit from sharing of new varieties, to others.

I know the women of Pukapuka sent Taro shoots to Palmerston Island, Nassau and southern group Islands to try and save what varieties they still had, in order to save them.

So if you have new varieties of Taro and Cassava, most low lying atolls would benefit, especially if they can survive brackish water and poor soils.

11. Submission from Viliamu Iese, Pacific Centre for Environment and Sustainable Development (PaCE-SD)USP (13/4/18):

First, I totally agree with the points raised by earlier contributors on the significance of working to address pests and diseases as well as agroforestry-aqua-livestock approaches. We really do need to consider biological hazards (pest and diseases) and how climate change will affect them in our adaptation strategies. It is important to look at the resilience of the whole system including the farmers and fisherfolks themselves.

My contribution is two-fold, especially looking at **B. Methods and Approaches for assessing adaptation, adaptation co-benefits and resilience**.

It is crucial we look at how effective our adaptation practices have been so far. I'm sure there are hundreds if not thousands of agriculture-food security types of adaptations that have been carried out at all levels in PICs - communities, national and regional level. They are in forms of policy, legislation, and on-ground actions as well. We need to capture the good practices that have been working well, taking into consideration the unique vulnerability and risks of each community and each country. The evaluation needs to consider the specific hazard(s) the adaptation was meant to address. I think in moving forward, we need to identify the limits of our adaptations and looking at

risk tolerance, residual risks and loss and damage. This will enable us to identify transformation /adaptation that can work well for specific challenges, both short term and long term. I'm sharing this because we in the Pacific Centre for Environment and Sustainable Development, USP worked with UNESCO to develop a simple community based toolkit to evaluate climate change loss and damage and effectiveness of adaptation at the community level. This tool was launched in Bonn during the COP23. We trialled it in Timor Leste, Samoa, Fiji, Cook Islands and Solomon Islands. The tool targeted Agriculture and Tourism Sectors. Interestingly, there were two major story lines that came out of the evaluation.

1. All adaptation worked BUT only successfully during good times. The Monitoring and Evaluation component of Agriculture adaptation measured the "success" only in good times. So the communities had lots of food, and managed to sell excess supply, during the fine weather times. The biggest question came up when we tried to evaluate the adaptation against the "real" reasons why the intervention was established at the first place. If it was done because of a drought/salinity/flood/cyclone etc., we asked if the specific adaptation worked against the real hazard it meant to address. This is where the second story came about:

2. Only 5 % of communities and farmers mentioned the adaptation totally worked - these adaptations were mainly the ones where farmers moved the farm away from the hazard (coastal/saline areas or rivers) - reducing the exposure level of farms. But all others were effective to some extent but about 95% of farmers still experienced loss and damage after extreme and slow onset events. Hence the storyline - We are always in "recovery mode".

In sharing this I do hope it will create discussions on:

1. Capturing the good practices that are existing and

2. Including loss, damage and limits of adaptation (soft and hard) in our future adaptation plans and implementation. This is in in line with Article 8 of Paris Agreement and the Warsaw International Mechanisms for Loss and Damage.

Use of Decision Support tools

The second point I want to stress here for discussion and consideration is the use of decision support tools in our agriculture risk assessments and future adaptation. I'm referring to tools such as Crop models, water models etc. In our region there are lots of efforts to improve climate services and also soil information. We need to invest more to continue to improve these climate services and soil information processes. Having these decision support tools available, and the capacity to use them, will enable us to combine weather data, soil data, farm management, pest and diseases (hopefully this component will improve in the future) and genetics of plants/cultivars into our simulations. This will help us to quantify the impacts of past, current and future climate change and climate variability on specific crops. (I think SPC have fisheries models that can be used too.) The models are for monocultures, intercropping and agroforestry-livestock as well. They are helpful tools in quantifying the impacts of future climate change scenarios and looking at the feasibility of our adaptation plans before implementation.

The models are not perfect and some of our important crops are not in the models yet, but this is an opportunity to start discussing improvements. We do have crop model capacity now started by projects in USP and SPC in partnership with our national governments, private sector, NGOs, Universities in US and also Australia and CSIRO, ACIAR etc, funded by USAID, AUSAID (when it was Ausaid), and scholarship support from EUGCCA. These tools will help us reduce trials and errors and total reliance on analogy approaches by adding some simulations into our adaptation programs. These tools will work well with climate scenario produced by IPCC as well as weather forecasts and

seasonal forecasts produced by our local Met offices and regional partners. Other regions of the world are using these tools now.

There is a good Adaptation Approach from one Caribbean country where they use crop models to look at the effectiveness of 11 agriculture technologies to support technology transfer for agriculture adaptation. I'm not saying these models will replace our traditional ways of doing things, but they can add value to our discussions and decision processes. We already have all input information for these models - such as weather data, soil data, cultivar-specific growth rates, farmers' management practices, and modeling capacity (very minimal) existing in the Pacific. So we won't start from ground zero - we just need to add and improve. These tools can add value to ongoing germplasm distribution, evaluation, breeding and improve our agro-met networks, and can save a lot of time and money.

As I mentioned earlier, it is time we look at resilience through whole system approach rather than sectoral or specific hazard - climate change affects all aspects of our agriculture systems including the farmers, fishers, agriculture officers, researchers, everyone!!!!

12. Comment from Don Miller (13/4/18):

If climate change is to bring a higher incidence of intense rain events, as appears to be happening, then minimising soil loss becomes important. If that can be combined with terracing to increase infiltration, then run-off will also be decreased, along with peak flood flows. Vegetative terracing systems have been used in some tropical regions for hundreds of years and maybe this is the time to look at these again. They worked effectively on the sloping cane fields of Fiji for several decades.