Water and food security under a climate change scenario in the Pacific Small Island Developing States

A project to increase water and food system resilience of climate migrants settlements in the Federated States of Micronesia

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Under Climate change scenarios water security and food availability could be critical in areas traditionally known as rich in water and with high productivity level as countries and islands close to the equatorial belt. Changes in pattern of precipitation and/or extreme weather events can substantially decrease water availability and food security and affect quality of living till push people to abandon more vulnerable areas and move to safe places with larger resources availability. Traditionally populations living in those areas do not have the habit, experience and culture to save water or introduce crops more resistant to drought because the generous climate provides, all over the year, the water and food they need. But nowadays under the climate change scenario there is the urgent need to put efforts and implement actions to increase resilience to climate changes also in those countries. In the framework of the Cooperation Programme of the Governments of Italy, Austria, Luxembourg, Spain and of the Pacific Small Island Developing States (SIDS), sustained by the Italian government and implemented by the Italian Ministry of Environment and Land and Sea (IMELS) it has been set up and approved a project in the Federated States of Micronesia (FSM) with the aim to enhance water security and climate resilient food systems for the displaced atoll communities in Yap.

Communities of remote atoll islands of Yap State in the Pacific nation of the FSM are among the most economically disadvantaged and environmentally vulnerable groups in the western tropical Pacific. Environmental problems associated with climate variability, like sea level rise, coastal flooding, saltwater intrusion and lack of ground freshwater converge to place the atoll islands and other coastal settings, at the forefront of climate change. The climate change effects resulted in the forced migration of atoll population to higher lands in search of better living conditions. Lack of suitable arable land threatens food security at household levels. For the poorest and most vulnerable communities living on fragile and degraded lands, the response measures should address the deteriorating environmental conditions.

The Italian cooperation program under the UN umbrella aims to enhance access and sustainable use of quality water and food systems in Yap. The project will assist the displaced atoll communities with necessary outreach, technical assistance and training opportunities. This will enable them to adopt, maintain, improve and monitor water and food systems in the context of climate variability. The planned adaptation strategies will feed into capacity development process and would like to be an important step to assist the government towards a pathway for climate-resilient development.

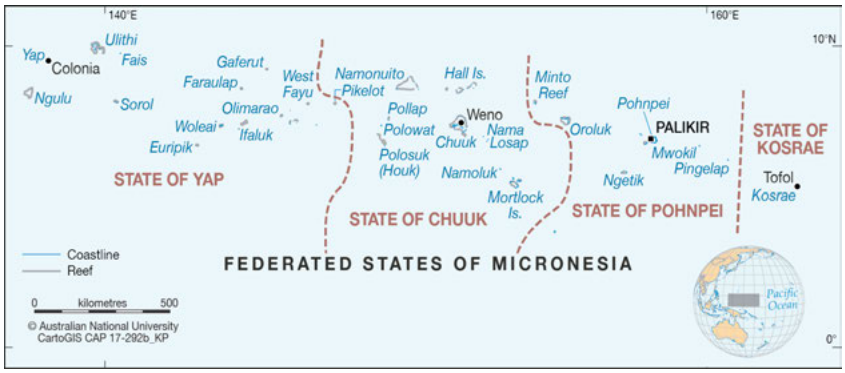

Fig. 1 Federated States of Micronesia Islands and atoll in the Pacific Ocean

Context and background

The FSM occupies a major part of the group of Micronesian Islands called the *Carolines*, a chain stretching over 1,500 miles in an east-west direction roughly parallel to the equator (Figure 1). Yap State is the westernmost State in the FSM and consists of Yap and 14 atoll islets that are inhabited by traditional communities. The 2010 state-wide population was about 11,376 of which about 7,370 reside on Yap and 4,006 reside on outer atoll islets. [1]

With an Environmental Vulnerability Index score of 392, the FSM is

Fig. 2 Yap Proper Island and its coral reef from Satellite

currently one of the highly vulnerable Small Island Developing States (SIDS) in the Pacific. Communities living in these islands are already experiencing higher temperatures, shifts in rainfall patterns, rising sea levels and changes in frequency and intensity of extreme climatic events. Further changes are expected in the coming decades because of climate change associated with global warming and regional ENSO phenomena. Changes of this magnitude are having a profound impact directly on the livelihoods of islanders, particularly in terms of cultural heritage, socio-economic wellbeing, personal health and safety.

The climate variability is influenced by the El Niño Southern Oscillation (ENSO) phenomena. This results in severe localized droughts in some years and chronic floods, the increased frequency, strength and location of tropical cyclones and sea level height [2]. The climatic changes are affecting every aspect of life of coastal communities in Yap due to the small size of islands and atolls, lower elevations and extensive coastal areas. Further changes are projected long into the future [3] and the recurrence of disasters and crises threaten the food security through impacts on traditional agriculture. Many of the projected impacts are now unavoidable, implementing some degree of adaptation is essential to enhance food security, strengthen livelihoods and increase the resilience of coastal communities to future climate risks.

The main island of Yap, known as Yap Proper, consists of a group of four major conjoined islands (Figure 2). Yap Proper occupy 38 square miles whereas outer islands/atolls collectively occupy about 7.32 square miles.

The nationwide Integrated Disaster Risk Management and Climate Change Policy of the Federated States of Micronesia (FSM) aims to achieve economic growth and self-reliance within a framework of sustainable development. Food, water and energy security is one of the strategic outcomes of this policy. Whereas one of the strategic objectives of the FSM Development Plan 2004-2023 urge to ensure environmental migration is managed to the extent possible including the protection of displaced populations.

Strong interdependencies exist between food security and rural water security that addresses questions related to inclusive economic growth, decent employment, social protection, access to clean water, health and natural resources management all issues strongly linked to the UN SDGs goals.

The FSM runs a large trade deficit, with imports being around ten times larger than exports. Food and fuel represent a significant proportion of this, comprising 46.6% of total imports to the FSM in 2007. The

Fig. 3 Traditional taro patches in Yap. Taro is a traditional local staple food crop, its root are largely cooked in the villages

FSM is highly and increasingly dependent on these food imports, and total food imports showed a steep increase from US$17 million to US$43.6 million in the nine years to 2009 [4]. Any increase in global food and oil prices will reflect in simultaneous increase in costs of imports, and will have serious implications for the FSM's terms of trade.

The incidence of families with incomes below the poverty line in the FSM is among the highest in the Pacific region, as is inequality of income. Approximately 10% of people in the FSM are below the Food Poverty Line. However, only 4% of the population of Yap falls below this threshold.

Economic activity in the FSM consists largely of subsistence farming and fishing, and government, which employs two-thirds of the adult working population.

Traditional economic activities in Yap include sailing, weaving, subsistence farming and fishing.

The potential for tourism is limited by isolation, lack of adequate facilities, and limited internal air and water transportation.

Despite the uncertainty that exists in relation to the magnitude of climate change impacts, what is evident is that traditional agriculture in Yap is facing, and will continue to face, in the coming years from climate change [5]. Yap's sustainable food production system- traditional agroforestry system – is dominated by agroforestry system and taro patches [6]. Most subsistence crops are grown along the coastal plains. Taro patches (Figure 3) along the coastal plains and atoll settings are especially vulnerable to sea level rise, storm surges and saltwater intrusion that are already occurring and observations and market data suggest that the traditional food production system has been reduced in extent and productivity over the last two decades [7].

Fig. 4 A modern current type of for rainwater roof collection and storage

Migration as an adaptation strategy

Atoll communities in the FSM have been facing the implications of climate variability and change for the past two decades in different ways: i) intensification of natural disasters, ii) increased warming and drought and access to clean water, iii) saltwater intrusion making subsistence crop production impossible, and iv) accelerated coastal erosion and more frequent inundation making coastal areas uninhabitable. Low adaptive capacity forced these communities to migrate to the highlands on Yap Proper in search of better living opportunities [8] [9].

Displaced atoll communities on Yap Proper reside principally on five settlements: Gargey, Daboch, Ruu, Makiy and Gitam for a total of about 130 households and more than 900 people. Four of these settlements are located on the Gagil-Tomil plateau on Yap Proper. The areas were barren until 2004 when displaced atoll communities began colonizing gradually after the devastation from typhoon Sudal. In the aftermath of this natural disaster, rehabilitation programs expanded significantly across the State, with hundreds of households established across four major settlements, however, without effective livelihood support initiatives. The vulnerability of displaced atoll communities was exacerbated by relocation to a degraded landscape. The sudden movement of atoll communities into a degraded landscape on Yap Proper, which *de jure* belongs to local government but under the *de facto* control of local atoll communities, placed additional strain on livelihood support systems, often exacerbated by atoll communities being unfamiliar with crop production

practices on degraded landscapes. There is an urgency to prioritize the creation of an action plan for these atoll communities and implement it to enhance their adaptive capacity and climate resilience.

Resilience on the ground

The project under development is to enhance access and sustainable use of quality water and food systems as a climate change adaptation strategy in Yap with three main outcomes:

Outcome 1:
Improved water infrastructure for catchment and storage in place for 5 atoll community settlements in Yap

Outcome 2:
Climate resilient food production systems of vulnerable communities strengthened at households level

Outcome 3:
Education and awareness on sustainable water use and conservation and food production systems in the context of climate change enhanced in Yap.

Water is the prime channel through which the impacts of climate change are felt by the atoll communities. Yap experienced below normal rainfall and severe drought associated with the 2015/16 El Niño. The 2015 fourth-quarter rainfall of 344 mm at the Yap Weather Office was the driest such three-month total in the post-WWII historical climate record. While the annual rainfall of 2015 was 90.2% of normal, 2016 data was 80.1% of normal recorded for Yap between 1981 and 2010. The effects of low rainfall included a complete drawdown of the municipal reservoir and wildfires that scorched roughly four percent of the land area of Yap Proper. The El Niño-induced drought caused atoll communities to move afar to fetch water from distant locations.

The project foresees actions that increase the capacity to store and access water when needed increase the communities' resilience to climate variability. Therefore, this program primarily focuses on domestic rainwater harvesting and storage from house roofs (Figure 4).

Current rainwater harvesting systems and storage systems are absent or inadequate to meet community needs. Modern and updated system will provide to each community enough water to fulfill the WHO target of 15 liter per capita per day.

In terms of impact, successful establishment of rainwater catchment systems will bring clean water to every household of the atoll communities and will provide also water for emergency irrigation.

Realizing the importance of nutrition and food security for enhanced action on adaptation, household sustainable food production systems will be introduced and promoted using climate-smart, alternative-crop production practices in complement with soil-restoration strategies.

Soils in this area are degraded without any topsoil, and thus carbon, and highly acidic with soluble aluminum. These chemical properties prevent field-based cultivation challenging for the communities.

Communities lack practical and proven tools to produce increased quantities of food on a degraded landscape. This will be achieved through restoration of degraded lands by utilizing sustainable soil management practices and crop production intensification through mosaic restoration approaches and climate-smart agriculture strategies such as:

- Producing compost at households level
- Organic soil amendments to help to increase soil carbon content
- Incorporation of trees in the landscape and small household garden.

Trees could increase water availability in the soil by reducing runoff and evapotranspiration, while increasing water infiltration and soil water holding capacity, moreover filtered shade conserves water, reduces evapotranspiration, keeps topsoil cool, and helps maintain beneficial microbial activity.

Agroforestry systems often combine short-term and long-term crops, which can lead to a high level of total productivity and year-round production, they are most undervalued but they are very important for human adaptation to climate change. In this program, community-based, culturally compatible agroforestry systems will be promoted. The agroforestry will incorporate species and techniques that have been used traditionally in Pacific islands for many generations. By combining production with conservation and land improvement, the agroforestry approach will increase the acceptability and adoption of sustainable practices.

Integration of trees with traditional crops, household gardens, and innovative methods such as raised-bed gardening, container home gardening, micro gardens, and small-plot intensive (SPIN) farming will ensure the nutrition and food security of displaced communities.

Moreover for the successful project implementation a mix of different

education and communication strategies will be used to provide capacity building. Field workshops and hands on training sessions will be conducted periodically across all targeted community settlements to establish household water conservation and innovative food production systems. The overall implementation of project activities could provide in the near future useful information and experiences for other FSM island as well neighboring countries that are facing similar challenges and act as a test case both for the UN2030 SDGs and for the FAO WASAG initiative that deals with water scarcity in agriculture [10]. Under the climate change scenarios water scarcity is not an exclusive phenomena of the traditional driest regions of the world and actions to adapt and counteract water scarcity must be put in place also in rainy regions mixing different resilient methods and technologies.

Note: This project will be implemented by the Cooperative Research and Extension, College of Micronesia-FSM Yap Campus in cooperation with local and regional partners under the supervision of ENEA. The Cooperative Research and Extension Program is funded by United States - Department of Agriculture through College of Micronesia land grant program.

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REFERENCES

1. FSM Census Bureau, 2010: *FSM-Wide Census of Population and Housing 2010*, Yap State. Office of Statistics
2. Lough, J., Gupta, A.S., Power, S.B., Grose, M.R., & McGree, S., 2016: Observed and projected changes in surface climate of tropical Pacific Islands. In Taylor M, McGregor, A. & Dawson B, eds. *Vulnerability of Pacific Agriculture and Forestry to Climate Change.* Noumea: Secretariat of the Pacific Community, p. 47-102
3. Australian Bureau of Meteorology & CSIRO, 2014: *Climate Variability, Extremes and Change in the Western Tropical Pacific: New Science and Updated Country Reports.* Pacific-Australia Climate Change Science and Adaptation Planning Program Technical Report, Melbourne, Australia, 358 pp.
4. Government of the FSM, 2012: *Federated States of Micronesia Agriculture Policy 2012-2016*
5. Taylor, M., McGregor, A., & Brian Dawson (eds.), 2016: *Vulnerability of Pacific Agriculture and Forestry to Climate Change*. Pacific Community, Noumea, New Caledonia
6. Falanruw, M.V.C., 1993: Micronesia agroforestry: Evidence from the past, implications for the future. USDA Forest Service General Technical Report, PSW-GTR-140
7. McGregor. A., Taylor, M., Bourke, R.M., & Lebot, V., 2016: Vulnerability of staple food crops to climate change. *In:* Taylor, M., McGregor, A., & Dawson, B. (eds). *Vulnerability of Pacific Agriculture and Forestry to Climate Change.* Pacific Community, Noumea, New Caledonia
8. Krishnapillai, M., 2017: "Climate-friendly Adaptation Strategies for the Displaced Atoll Population in Yap". In: Leal Filho, W. (Ed) *Climate Adaptation in Pacific Countries: Fostering Resilience and Improving the Quality of Life*. Springer, Berlin; p. 101-117
9. Krishnapillai, M. & Gavenda, R., 2014: From barren land to biodiverse home gardens. *Farming Matters*, 30: 26-28
10. FAO, 2016: Coping with water scarcity in agriculture a global framework for action in a changing climate. The Global Framework on Water Scarcity in Agriculture (WASAG) initiative concept note. http://www.fao.org/3/a-i6459e.pdf