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# Facing food security risks: The rise and rise of the sweet potato in the Pacific Islands

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ABSTRACT

Pacific Island communities are highly exposed to a range of hazards including extreme weather events and outbreaks of pests and diseases. These hazards can cause severe losses to yields of traditional food crops and increase the risks of famine and food insecurity in Pacific Island communities. Historically, the cultivation of sweet potato enabled communities to adjust their farming systems and reduce food security risks before, during and after disasters. The food security features of sweet potato contributed to its adoption as a staple crop by communities at the "edge" of agro-ecological limits for their traditional crops. Sweet potato was also adopted as a supplementary crop, adding nutrition and stability to communities' food systems. In present times, sweet potato is being cultivated as part of food security and climate change adaptation projects in Pacific communities. This has been facilitated by regional mechanisms for sustainable use of plant genetic resources. But as climate change continues to intensify extreme events and cause sea levels to rise, the resilience of current sweet potato varieties is not guaranteed. Sweet potato, like other Pacific staple crops, is not 100% "disaster-proof". There is a need for multi-partner, proactive agro-ecological based research on sweet potato and other staple crops to reduce both short-term and long-term food security risks faced by Pacific Island communities.

## 1. Introduction

> *"Climate change will adversely affect food systems in the region, including the supply of food from agriculture and fisheries, the ability of countries to import food, systems for the distribution of food, and the ability of households to purchase and utilize food"* (Barnett, 2011).

Pacific Island communities are highly exposed to climate change impacts and other hazards, threatening food security. Pacific Islanders are experiencing prolonged droughts, intense flooding, severe tropical cyclones and storm surges (Sisifa et al., 2016). Although the Pacific has always experienced extreme weather events, these are becoming more severe and occurring more frequently as a result of climate change. Furthermore, Pacific communities are experiencing an increase in 'slow onset' impacts of climate change: global average sea level has risen by between 2.8 and 3.6 mm per year since 1993 and some Pacific Island Countries have experienced a rate of sea level rise that is four times the global average (Nurse et al., 2014). The average temperature and the number of hot days is also rising (Lough et al., 2016).

As agriculture is the main source of food, livelihood and income for many Pacific Island communities, the impacts of extreme weather events on this sector are highly critical. Severe droughts, intense floods, salt water inundation and intrusion and tropical cyclones reduce both crop yields and total production, increasing the risks of food insecurity in communities (Iese et al., 2016; McGregor et al., 2016a, 2016b). Most rural people in the Pacific rely directly on staple crops and farming for food. In Papua New Guinea, just over 80% of the population are rural villagers who grow most of their own food (Bourke and Harwood, 2009). In the Solomon Islands, between 80% and 84% of the rural population rely on crops and farming (Evans, 2006; Wairiu et al., 2012; Government of Solomon Islands, 2014). In Vanuatu, between 70% and

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80% of people in rural areas rely on crops and farming (Bourke, 1999; Allen, 2015), and in Tonga, between 50% and 60% of people in rural areas rely on crops and farming (FAO, 2008).

Pacific Island communities' leadership in resilient practices against disasters and climate change is well documented (Sudradjat, 1997; Allen and Bourke, 2001; Bourke, 2005b; Wairiu et al., 2012; Allen, 2015; Iese et al., 2015, 2016; McGregor et al., 2016a, 2016b; Taylor et al., 2016a, 2016b; Thomson et al., 2016). Communities have combined accumulated traditional knowledge and modern technologies to improve the resilience of their cropping systems by adopting a "no regrets" approach to decision making. "No-regrets" actions can be justified from an economical, environmental and social perspective whether or not climate change impacts and other natural hazards occur. Such actions increase the resilience of a system including its ability to deal with multiple hazards in an efficient, equitable and timely manner. In the context of agriculture and food security, one example of a no-regrets action is pursuing crop diversification through intercropping and crop rotation. Planting a high diversity of crops has no adverse impacts but increases the likelihood of at least one crop surviving if a hazard strikes. Another technique for reducing food insecurity is selecting and adopting crops that have resilient features, making them beneficial for increasing food security. Through these and other techniques, Pacific Island communities have managed to stabilise crop yields, reduce losses and damages and reduce the risk of food insecurity.

One of the success stories of selection and cultivation of resilient crops for food security was sweet potato being distributed, integrated and adopted in both traditional and modern agriculture systems in Pacific Island communities. Whilst its pre-historic and historic patterns of distribution and adoption have been widely researched (see Yen, 1974; Bourke, 1985; Allen, 2005; Ballard, 2005; Green, 2005; Leach, 2005; Roullier et al., 2013a, 2013b, 2013c), the recent increase in distribution and adoption of sweet potato across the Pacific is an under-investigated area of research.

This paper argues that sweet potato has been in the past, and continues to be, an important food security crop in many Pacific Island Countries. The importance of sweet potato to the Pacific is likely to continue to grow into the future, as sweet potato varieties have many resilient features that make its distribution and adoption more likely in the face of increasing slow and fast onset impacts of climate change. We demonstrate this argument by first discussing the food security features of the sweet potato. We then describe the history of the sweet potato in the Pacific, including the crucial role it played in reducing food insecurity in the past, facilitating population growth and enabling Pacific Islanders to cope with, and recover from, disasters. Next, we discuss the current role of sweet potato in the Pacific including its increased distribution and cultivation as part of various climate change adaptation and food security projects. Finally, we discuss the future potential of sweet potato in assisting Pacific communities to reduce food security risks and improve their resilience against regional and global environmental changes. Suggestions for research directions to support the important future role of sweet potato include targeted breeding programs, crop model development, multi-site evaluations and continued documentation of adoption processes at both the community and national levels.

## 2. Food security features of sweet potato

Globally, sweet potato is the seventh most consumed carbohydrate-rich food (Chueyen and Eun, 2013). About 105 million t of sweet potato was produced in 2016. China produced 71 million t in that year, making it the world's largest producer. Papua New Guinea produced around 700 thousand t in 2016 making it the only Pacific Island Country to be included in the list of the top 20 largest sweet potato producers globally (FAOSTAT, 2016). In the Sub-Saharan region, sweet potato provides the highest edible energy per hectare per day of all local food crops. It is a primary staple crop in Rwanda, Burundi, Malawi and parts of Uganda and is a secondary staple in eastern and southern Africa (Low et al., 2017).

In the Pacific Islands, sweet potato is the most important staple food crop in terms of total locally produced calories (McGregor et al., 2016a, 2016b). Its cultivation and use in the islands varies. Sweet potato is an important staple crop in Papua New Guinea and the Solomon Islands. Rural villagers in Papua New Guinea consume about 670 kg/person/year and sweet potato makes up almost two-thirds of the staple food crops both by weight (64%) and food energy (63%) (Bourke and Vlassak, 2004). Sweet potato represented about 65% of all food crop production in Solomon Islands in 2004 (Bourke et al., 2006). In Fiji, New Caledonia and Vanuatu, sweet potato is a supplementary food crop but with increasing importance in food, nutrition and livelihood security (Thaman, 1990; Bourke, 1999; Allen, 2005). Sweet potato is also an important cultural and food crop in New Zealand, Easter Island and Hawaii (Ladefoged et al., 2005; Leach, 2005; Wallin et al., 2005a, 2005b; Roullier et al., 2013a, 2013b, 2013c). For Polynesia and the low-lying islands and atolls of Micronesia, sweet potato is increasingly popular because of its climatic and ecological resilience (Iese et al., 2016; McGregor et al., 2016a, 2016b).

The many resilient features of sweet potato are what make it such an important food security crop across the world. Table 1 below outlines the features of the sweet potato and how these relate to the four pillars of food security, namely availability, accessibility, stability and utilization.

Availability (AV) refers to the physical availability of food. The features that contribute to the availability of sweet potato include its ability to grow on both rich and poor sandy soils, its ability to grow non-seasonally in tropical regions, its good storage properties, its high yield per hectare, its demonstrated drought and salt tolerance, and its resistance to some pests and diseases. These features ensure that sweet potato plants produce a yield that is available when communities need food.

Accessibility (AC) refers to factors that enable households to access food. This is not necessarily guaranteed by sufficient supply at the national level. Accessibility generally refers to economic factors such as household income, expenditure and food prices. In the Pacific context, the fact that sweet potato can grow non-seasonally and is available all year, is able to tolerate some pests and diseases and can be farmed close to the house enables communities to access the sweet potato for food when needed. Furthermore, the involvement of women, children and men in cultivating sweet potato increases the accessibility of the crop. Households can also sell sweet potato to obtain income to purchase other food to diversify their diet.

Utilization refers to the ability of the body to utilize the nutrients in food. This includes the nutrition and health benefits of consuming sweet potato. It is well documented that consuming orange sweet potato reduces vitamin A deficiency in women and children in Uganda and other Sub-Saharan African countries (Haskell et al., 2017; Low et al., 2017). Orange sweet potato roots are rich in bioavailable beta-carotene, vitamin C, K, E and several B vitamins (Lebot, 2010, 2017; Low et al., 2017). Some varieties in tropical countries such as PNG, Vanuatu and Melanesia have low sugar content as well as low glycemic index (Lebot, 2017).

Stability refers to the sustainability of the other three food security pillars. Having an adequate supply of food and being able to access and utilize that food can be interrupted on a periodic basis as a result of extreme weather events, political instability or other factors (FAO, 2008). Sweet potato with its resilience and its ability to grow quickly ensures people have access to food before, during and after disaster events. As further explained later in this paper, the overlapping roles of many sweet potato varieties help to fill the "gap" in traditional food production systems in Pacific Island Countries, making sweet potato a very important crop for food security stability.