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Maximizing Value Chains in Root and Tuber Crops in the Pacific Island Countries
Issues, Constraints and Policy Directions

Edited by Mohammed Umar, Satish Chandra and Rup Singh

2015
Executive Summary

This issue summarizes the proceedings of a regional training workshop on Root and Tuber Crops (RTCs) organized by the University of the South Pacific – Institute of Research, Extension and Training in Agriculture (USP-IRETA) in conjunction with Technical Centre for Agriculture and Rural Cooperation (CTA) and the International Society for Tropical Root Crops Pacific Branch (ISTRC-PB). The five–day training workshop comprised researchers, academics, farmers, government officials, private sector and the international donor agencies.

This volume which covers six Pacific Island Countries (Samoa, Tonga, Fiji, Vanuatu, Cook Islands and Papua New Guinea) is useful for future researchers and policy makers in Pacific agriculture. The value chain analysis provides useful information to various stakeholders in the industry; especially where intermediation, agro-processing and fair trade are concerned.

The papers presented identify key issues and challenges in RTCs and the strategic directions that each of the countries are taking to improve their agricultural productivity and livelihoods of various stakeholders, especially the rural and remote farmers.

A number of challenges have been identified. These include, but are not limited to, declining farm productivity, intensifying global competition, threats of climate change, developments in agri-business potentials, smart agriculture and use of technology to break barriers of production and trade. These could promote maximizing crop yields, value chains, incomes and livelihoods of the respective stakeholders in agriculture.

The major strategies for maximizing value chains in the short-medium term are stated to be farm infrastructure, production technology and market networks. In the longer-term, capacity building and innovative research are the key. Technical institutions, private sector, international agencies and regional governments have a definite role to play in this endeavor.

I wish to congratulate the editors for bringing this volume to light.

Professor Rajesh Chandra
The Vice Chancellor and President
The University of the South Pacific (USP), Suva, Fiji Islands.
Acknowledgements

The editors deeply acknowledge the support of the following persons and organizations.

- The USP-IRETA, CTA and ISTRC-PB for providing funding support in bringing the regional and international experts to the training workshop in Nadi (Fiji) in November 2014.
- The University of the South Pacific for arranging travel, lodging and financial logistics for the participants and the experts.
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E-mail: uspireta@samoa.usp.ac.fj

Annual Subscription
Free to agricultural workers in USP member countries.
US $40.00 (including postage for non-USP member countries).

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Acknowledgement
The Journal of South Pacific Agriculture hereby acknowledges the generous contributions of those who reviewed manuscripts for this volume.
Importance of Tropical Root Crops in the World and Maximizing Value Chains in the Pacific Island Countries

Satish Chandra

OVERVIEW

Tropical root crops are major staple foods in the world, mostly consumed as fresh foods. These crops help to alleviate poverty on a wide scale, especially in the developing countries of the tropics and sub-tropics. They provide food security to billions of people, most of whom comprise poor and vulnerable groups who would otherwise have few food choices. Tropical root crops are important in raising farm incomes in remote rural settings where there are few other income-generating opportunities. They have enabled new food industries and industrial products to be developed. Tropical root crops enable a more sustainable, energy-efficient and environmentally friendly agriculture to be practised across vast regions of the globe. Tropical root crops ensure greater world food security and help to maintain and nurture sustainable human societies in many regions of the world.

The main tropical root crops are potatoes (Solanum tuberosum), cassava (Manihot esculenta), sweet potatoes (Ipomea batatas), yams (Dioscorea rotunda and D. alata) and taro (Colocasia esculenta) from the aroids family. Other less important aroids are tannia (Xanthosoma sagittifolium), giant taro (Alocasia macrorrhiza) and giant swamp taro (Cyrtosperma murkessi).

PRODUCTION AND CONSUMPTION

The current annual world production of tropical root crops is 765 million tonnes (mt). The most recent world data for all tropical root crops is for 2013, provided by the Food and Agriculture Organization (FAO) of the United Nations. The world production of tropical root crops has increased from 688mt in 2001 to 765mt in 2013, with an average annual growth rate of around 1.0%. Over 1.5 billion people in the world consume tropical root crops regularly as their basic staple food.

Potatoes were first domesticated in the Peruvian highlands near Puno more than 9,000 years ago. Now they are mainly produced and consumed in the developed countries in the temperate regions of Europe, North America, Southern South America, Northern Asia and Oceania which together accounts for 75% of world’s production of 333mt. Potato production in these regions is highly mechanized, based on high-energy input agriculture and sophisticated production technologies leading to high yields at around 30-40t per ha/year. In these regions, the marketing and processing systems for potatoes are also highly developed.

In the temperate countries, potatoes are mainly consumed in boiled, baked, mashed or fried forms such as French fries and potato chips, or converted into industrial products such alcohol and starch. In European countries the consumption rate of potatoes varies from around 55kg per capita/year in France, 102kg per capita/year in UK to 180kg per capita/year in Belarus. Only 25% of world’s production of potatoes originates in the tropics of Central and South America, Asia, Africa and Oceania. Here it is consumed mainly as boiled, baked or mashed.

Cassava, sweet potatoes (both domesticated in north east Brazil), yams (domesticated in west Africa) and taro (domesticated in south east Asia) are mainly produced and consumed...
in the developing countries in the tropical regions of Africa, Central and South America, Asia and the Pacific Island Countries. The world production of cassava is 237mt, sweet potatoes 130mt, yams 53mt and taro 12mt (FAO, 2013).

Cassava is often processed because of the perishability of the fresh roots and the presence of cyanogenic compounds, which mainly occur in bitter varieties. In some West African countries, cassava is made into gari through grating of fresh roots, fermenting the mash and roasting. This reduces the level of cyanogenic compounds to acceptable levels. In other parts of the world (including the Pacific) only sweet varieties of cassava exist that contain lower levels of cyanogenic compounds.

In several countries in Africa, such as Nigeria, Democratic Republic of Congo, Ghana and Uganda, the consumption rate of tropical root crops exceeds 325kg per capita/year. In the South Pacific Island Countries of Papua New Guinea, Solomon Islands, Samoa, Tonga and Cook Islands, the consumption rate of tropical root crops exceeds 225kg per capita/year.

Africa produces about 215mt of tropical root crops or about 28% of the world’s production. Africa is the world’s largest producer of cassava at 122mt (51% of the world’s production), yams 51mt (96%) and taro 10mt (83%). Nigeria produces about 70mt of tropical root crops and has a consumption rate of around 440kg per capita/year.

China produces 80% of the world’s sweet potatoes (104mt), which are consumed mainly in fresh form or processed into noodles and other food products. Around 20% of sweet potato production in China is processed into animal feeds, mainly for pigs and poultry. Sweet potato leaves, which are high in nutrients and dietary fibre, are consumed in some countries as well as used as animal fodder.

The world consumption rate of tropical root crops is around 110kg per capita/year. Globally cassava, sweet potatoes, yams and taro are generally produced and consumed by subsistence and semi-subsistence households who practise low input, low-energy consuming production technologies to achieve modest yields of around 7-10t per ha/year. These households are generally poor with few physical and capital assets; their greatest production input being family labor. Their land holdings are generally acquired through customary tenure. Despite this low-level resource base, the tropical root crop production systems are generally efficient and sustainable.

**Food Security**

The importance of tropical root crops for food is that they supply high amounts of food energy for relatively small efforts made in their production. In large parts of Africa, Central and South America, Asia and the Pacific, tropical root crops have very high efficiency ratios. For instance, a cassava yield of 25t/ha generates an edible yield of around 137 million kJ, which are enough daily food energy requirements of 100 adult males for 150 days. However, root crops have low levels of crude protein ranging from about 1% for cassava to about 3-4% for sweet potatoes, yams and taro. Tropical root crops also supply large amounts of carbohydrate and bulk in the human diet, and because they can be produced throughout the year in the tropics, they are critical for meeting the daily food requirements of millions of households in the world.

The orange-fleshed sweet potatoes varieties are important suppliers of vitamin A, the lack of which in the diets of children in Africa and Asia leads to blindness, growth retardation, increased level of morbidity and reduced reproductive capacity. Vitamin A deficiency affects over 127 million pre-school children in the world. Sweet potatoes researchers have addressed this problem through breeding of more resilient orange-fleshed varieties for dissemination to farmers in the vitamin A deficient regions. A large share of funding for this type of research and subsequent dissemination of improved and disease-free planting material to farmers comes from international sources.

Societies based around tropical root crop production and consumption have survived for centuries in Central and South America, West Africa, South and East Asia and in Papua New Guinea. Several civilizations in the Andean mountains, going back thousands of years, cultivated many varieties of potatoes as their main staple food. These civilizations also developed storing technologies, including pit storage and sun drying, which ensured greater food security.

Over 500 years ago, the region comprising Nigeria, Benin, Togo, Ghana and Ivory Coast, had developed a yam calendar based around the characteristics of yam plant. This yam calendar was critical in maintaining food security of societies. The yam plant begins growing when a certain day-length is reached and around 10 months later the tubers are ready for harvest when the yam vines wither. The society elders...
ensured that only on a certain day could the yam harvest begin, thereby preventing any earlier harvest which would have reduced total yield and increased food insecurity during later parts of the year. Sometimes competition was held to see who could produce the largest yam tuber. Single yam tubers can be large, sometimes up to 60kg.

**Manufacturing**

Apart from potatoes, and to less extent sweet potatoes, international trade in fresh tropical root crops is small. Around 90% of fresh consumption of cassava, yams and taro happens within the countries of production. A challenge for marketing fresh tropical root crops is the high post-harvest perishability. This is particularly true for cassava and taro which start deteriorating within a few days of harvest, but less so in the case of potatoes, sweet potatoes and yams. Frozen fresh cassava, taro and yams for domestic and export markets are common in many countries.

Compared to potatoes, the processing of cassava, sweet potatoes, yams and taro is not highly developed. This is mainly due to low levels of investment in infrastructure and marketing systems and low disposable incomes in the countries where most of the tropical root crops are produced and consumed, which are invariably the developing countries. Processing and marketing of processed tropical root crop products in developing countries is expected to increase as incomes rise.

Smaller amounts of tropical root crops at the global level are processed into industrial products. These include high quality cassava flour for blending with wheat flour for bread making in Brazil, processing fresh cassava into farine for bread and cake making in the Caribbean, cassava chips for snack foods, dried cassava pellets for animal feeds, and cassava starch for food blends and industrial use. Some countries have large commercial industries that convert raw products into higher value products such as glucose syrup. Dried cassava pellets are important export revenue earners for small enterprises in Thailand and Indonesia. The bulk of the export from Thailand goes to China, with smaller amounts to Japan, South Korea and the European Union.

Biofuel made from cassava is important in Brazil, Malaysia, Philippines, Thailand, China, India and Nigeria. A study showed that 1 ha of cassava could produce 3,945 litres of cassava fuel ethanol in Nigeria. The return to the farmer from selling the cassava for fuel ethanol production was much higher than the sale of cassava as food.

A controversy has developed between groups supporting biofuel production from cassava and those supporting cassava as food. The latter group claims that the use of cassava for ethanol production is a waste of a critical food resource with the world facing hunger and poverty. Additionally, some agricultural scientists consider the mono-cultural cassava farming system for cassava fuel ethanol production to be unsustainable in the longer term. This is because of negative impacts on environment, such as deforestation and loss of biodiversity (large scale production of cassava generally requires clearing new land as in Brazil), and the loss of soil structure and decline in water retention capacity of soils. In addition, reducing the availability of fresh cassava for food in the surrounding area creates upward pressure on staple food prices, which has the greatest impact on poorer households.

The proponents of biofuel argue that economic development of countries is dependent on cheap energy supplies and by producing biofuel from cassava, it helps create local jobs and saving in foreign exchange. However, this group has no persuasive answer to the claims of environmental loss posed by cassava fuel ethanol production.

**Tropical Root Crops in the Pacific**

In the Pacific Island Countries, tropical root crops are very important staple foods, perhaps more so than other regions of the world because of greater per capita consumption rates. Papua New Guinea, the largest Pacific Island Country, is also the largest producer of cassava, sweet potatoes, yams and taro. Cassava is important in Fiji and Tonga whilst sweet potatoes in Solomon Islands, New Zealand and Tonga. Yams are important in Solomon Islands, New Caledonia and Fiji, and taro in Solomon Islands, Fiji, Samoa and Tonga.

Papua New Guinea is renowned for its wide gene pool of both edible and non-edible aroids, leading geneticists to conclude that Papua New Guinea was also an important area for the early domestication of aroids.

Other edible aroids such as Tannia, is important in Vanuatu, and Ta’amu or giant taro in Samoa. In the low-lying coral atoll islands of Kiribati and Tuvalu, Baibai or giant swamp taro is an important tropical root crop. It grows where...
no other tropical root crop or any other crop can survive because of the saline conditions of the coralline soils. Food security in Pacific Island Countries is highly dependent on tropical root crops.

Fresh export of taro from Fiji, for New Zealand, Australia and the United States markets, is worth around FJD15-20 million annually. However, the size and quality of taro corms are declining mainly due to the decline in soil fertility and imperfect agronomic practices. In Samoa, taro was devastated by the Taro Leaf Blight in 1993. Resistant cultivars have now been bred and widely disseminated, supporting the recovery of the taro export industry. Giant taro is also exported from Samoa. Fiji exports cassava and there is a small yam exports from Tonga as well. In the longer term, it is expected that a bigger fresh root crop export industry will develop in the Pacific.

Some countries in the Pacific are also developing manufactured value added products from root and tuber crops. For instance, potato and cassava chips are produced in Fiji and Samoa. Papua New Guinea produces several product lines from potatoes, cassava and taro including chips, flour, biscuits and confectionery.

**Challenges and Opportunities**

There are several key challenges ahead for maximizing value chains in tropical root crops in the Pacific. First, there is a need to improve profit margins along all the main links in the chain – not only at the final product end. Farmers and traders need to get a greater share of the potential profits that can be generated through value adding activities.

Second, there is a need to develop new tropical root crops based enterprises. Many countries in Africa, South America, Asia and Caribbean have extracted value from the manufacture of processed food and industrial products. These processes and technologies could be adopted or adapted in larger countries of the Pacific which have bigger production base.

Third, new markets for manufactured products need to be created whilst old markets need to be strengthened. Part of the marketing strategy needs to promote tropical root crops as highly nutritious food with low fat and sugar content.

Fourth, bio-security in the Pacific region is now a much more complex issue so there is a need to invest greater human and infrastructure resources to meet the higher standards of quarantine and regulatory requirements. It is in the interests of the various Pacific Island governments to support and assist this process. Finally, processors and exporters need to be proactive and have appropriate strategies in place to counter competition and threats from alternative products.

**Maximizing Value Chains**

There are several key lessons in maximizing value chains in tropical root crops in the Pacific. First, there is an urgent need to improve product quality in fresh products and to a lesser extent in manufactured products. Improving product quality will improve utilization of root and tuber crops, competitiveness and exports. A related issue is maintaining product quality once a quality standard has been established. Quite often businesses in the Pacific fail through not sustaining product quality over the long-term.

Second, presentation of fresh products for sale could be improved markedly. Good product display appeals to consumers and will help to generate a higher selling price. Exporters of fresh products need to continuously build and retain their customer base. Sustaining customer groups is critical for business success.

Third, there is a need for agribusiness to pull products through the value chain i.e. supplying a product that the customer wants. Farmers or farmer groups trying to push products through the supply chain will encounter difficulties. Good industry relations and adequate information flow between the various players in the value chain are critical for success. In addition, understanding the customers and satisfying their needs are critical for a successful business to develop and flourish.

**Conclusions**

Tropical root crops are important staple foods in the world. Around 765 million tonnes are produced annually and about a billion and half people consume tropical root crops regularly. The global consumption rate is around 110kg per capita/year. Tropical root crops have very high food security value. In several Pacific Island Countries, the consumption rate of tropical root crops is over 225kg per capita/year. In the Pacific, tropical root crops have much greater food security value than elsewhere in the world. Tropical root crops help alleviate poverty on a wide scale in many regions of the world. They help generate incomes in remote rural communities.

Tropical root crops will continue to be
important staple foods. Their worldwide distribution, ease of production, high level of sustainability in production and consumption systems, their ability to generate high amounts of food energy per unit of effort, their unique food product quality and taste and preference of consumers, and their competitiveness with the main grain crops such as wheat and rice in price and availability, leads to the conclusion that tropical root crops will remain a major staple food in the future.

Further Readings
The most valuable website is http://www.istrc.org. The publications and proceedings contain papers presented at the triennial Symposiums of the International Society for Tropical Root Crops going back to 1967. The website has over 2,000 papers, presented by the world’s leading researchers, and represents the current state of knowledge on tropical root crops. The papers cover a wide range of topics such as production, utilization, marketing, economics, consumption, nutrition, agronomy, breeding, diseases, pests, post-harvest, technology transfer, sustainable development and climate change amongst others. The papers also include key references to a large number of journal articles and books on tropical root crops.
Key Issues in Pacific Agriculture and Value Chain Analysis

Rup Singh

OVERVIEW

Despite the continued growth of knowledge capital and smart technologies resulting from research work, scientific studies, and innovations, agricultural productivity and consequently farmers’ incomes and livelihoods continue to remain poor in the Pacific Island Countries (PICs). This is due to the presence of distorted and unregulated markets, limited production volumes, high levels of market intermediation (which creates a wedge in prices unmatched by product quality), fragmented connectivity to major markets and the lack of up-to-date technical and market information made available to important players in the industry. Exhibition of best-farm practices, crop trials and availability of high-impact extension services have also been failing in the region. These factors discourage sustainable investment, employment and a stable career prospect for the youths and rural populations. Consequently, despite the rural development policies and Government funding to support rural economies, people continue to migrate to urban centers.

It is argued that if the PICs could significantly penetrate global markets or satisfy the growing consumer demands in the Asian region, farm profits, exports and economies of the agricultural societies could improve significantly. In addition, an efficient agriculture sector coupled with supporting infrastructure and trade facilitation could promote livelihoods and welfare of a good majority of the Pacific populations living in the rural area.

This paper summarizes the key issues and findings on the Value Chain Analysis (VCA) of PICs’ root and tuber crops production and trade. In general, these key issues include; the lack of information, need for fair trade and product standardization. However, unless the constraints in production and trade are minimized, realizing larger value in agriculture will remain impossible.

INTRODUCTION

Agriculture supports incomes and livelihoods of about 60% of the Pacific Islands’ population, especially those living in the rural, outer islands and remote communities, FAO (2008). It continues to represent an important share of economic activity in the PICs, despite the notable decline in its contribution to Gross Domestic Product (GDP) recently. Whilst the importance of agriculture in national economies, trade and food security is well-known, the productivity of this sector has seriously declined. This is mainly due to:

- Significant shift of investment, technology and human capital away from agriculture to higher-earned service oriented and manufacturing activities.
- Lack of interest in developing domestic agriculture because it involves significant income volatility, economic insecurity and unemployment.
- The younger generation finds relatively better alternatives and well-paid career options available in other fast growing and rewarding industries.
- Traditional knowledge and best farm practices or modalities seem to have been lost, reducing the knowledge base of potentially young and innovative entrepreneurs.
- Ideas and innovations to enlarge the scope of the existing semi-subsistence farms to commercial
large-scale agriculture are limited. These comprise the scale effects which can potentially break barriers to trade and growth.

More recently, the impact of climate change has begun to pose the first order challenge to farmers and other stakeholders of the industry. Unfortunately, these agents find difficulty with changing climatic conditions which seem to strongly impinge farm productivity, outputs and food security, IPCC (2014). Scientists have projected that by 2100, PICs would experience extreme weather patterns such as sea level rise by about 0.4m, surface air temperature to increase by over 2.3°C, large variability in rainfall, more frequent El Nino conditions, intensified tropical cyclones, saline intrusion into freshwater and increased flooding, SPC (2014). Climate change has important implications on the scope and type of land use, development of creative and smart agricultural practices and potential for alternative livelihood systems.

The Pacific region’s agriculture is limited with heterogeneous small-scale farms that are land-locked, operate using traditional systems, primal technology and limited innovation. Large-scale commercial farming is selectively practiced in different countries, for example, cattle, kava, copra and cocoa production in Vanuatu, cocoa, palm oil, kava, forestry and fisheries in the PNG and Solomon Islands, sugarcane, dalo, kava, vegetables, cattle, forestry, fisheries and livestock in Fiji and dalo and fisheries in Samoa, IFAD (2012). These dominate the fragile regional agricultural base. However, Australia, New Zealand and China see a huge potential in Pacific agriculture, especially in the fisheries, fruits and vegetables and forestry sub-sectors.

It is anticipated that support from regional Governments, international donor and technical institutions can help improve farm productivity and agricultural exports from PICs. However, equally important is the need for farmers to link with the growing international markets. Pitched at the optimal level of penetration, the global markets can offer profitable trade opportunities for sustaining incomes and livelihoods in the Pacific. Therefore, semi-subistence farming could be expanded to benefit from trade and scale effects.

Data show that the terms of trade for cereals, wheat, root crops and livestock and livestock products seem to have improved as their trade prices have risen to unprecedented levels. This is due to the short-supply resulting from low productivity and climate change effects. For certain certified organic varieties and country of origin, demand and consequently prices of agro-products have escalated due to people’s growing awareness of health issues related to excessive use of pesticides, increased development of Genetically Modified Organisms (GMOs) and bio-security risks. The health risks could be amplified due to poor and unsafe production methods. In addition, growing awareness of the prevalence of non-communicable diseases resulting from poor dietary habits has escalated demand for fresh produce, fruits and vegetables, FAO and WHO (2014).

The underdevelopment of commercial agriculture in the region is related to lack of investment, land tenure problems, weak networking of stakeholders, under-capitalized markets and the inability of farmers to sustain consistent export supply. Consistency in supply is not only related to the scale of production but also to consistency in product quality. Consequently, obtaining International Organization for Standardization (ISO) certification has become challenging for many aspiring commercial entities in the Pacific. The failure to have large commercial farms has also increased unit cost of production which results into high output price enough to undermine competition and trade penetration. Regional trade agreements provide some relief from these limitations, a summary of various provisions and debates surrounding agriculture trade agreements of the Pacific region are in CTA (2011). Important issues such as cross-border restrictions, rules of origin, product certification, use of pesticides etc remain important for agriculture trade policy in the region.

**Challenges for RTC Production**

Root and Tuber Crops (RTCs) are strategically important for the Pacific region. They provide a good source of carbohydrates, are easily cultivated, have a good market (both internally and abroad) and are a staple food for the region. Tropical root crops remain critically important in Pacific Islands’ diet, (FAO, 2010). This promotes self-sufficiency and import substitution to a certain extent. Although there seems to be some specialization, all of the PICs cultivate a mixture of the prominent varieties of the RTCs. Papua New Guinea (PNG) is the largest producer of cassava, sweet potatoes, yams and taro. Cassava is important in Fiji, Federated...
States of Micronesia and Tonga as well. Sweet potatoes are grown in the Solomon Islands and Tonga, whilst Yams in the Solomon Islands, Tonga and New Caledonia. Taro is important for the Solomon Islands, Fiji, Samoa and Tonga, FAO (2010). However, the level of production is far below that of the Sub-Saharan African countries, like Nigeria, Costa Rica and others, but there is a growing awareness to develop new and better varieties of RTCs in the region. In addition, some countries like Fiji, Samoa and the PNG have ventured into selected agro-processing and commercial activities of RTCs targeting both local and international markets. The key challenges for RTC are in the region include:

- Subsistence and semi-commercial production limits scale effects and value addition.
- Land suitable for RTCs is in contention with other agricultural and commercial activities.
- Inadequate land tenure that restricts innovations, risk-taking and sustainable investment.
- Lack of innovative varieties of RTCs to retain markets and keep pace with climate change.
- Lack of standard and quality assurance that promote agro-processing and market growth.
- High cost in cultivation, handling, preservation and post-harvest losses.
- Vulnerability to pests and diseases.

Countries have responded differently to these important challenges. Samoa, for example, which had lost its export market for Taro has now invested in developing varieties that are more resilient. Kiribati and Tuvalu have ventured into Giant Swamp Taro to deal with adverse climatic conditions. Fiji commercialized Taro production but agro-processing success of Cassava is limited due to supply constraints. Alternative uses of cassava in Fiji and Vanuatu have been abandoned due to high cost and food security issues. Nevertheless, there is a huge potential for all the PICs to trade RTCs in large scale globally and create additional value by investing into agro-processing.

A review of the agriculture policy on RTCs development for many of the PICs gives interesting insights. First, only a handful of countries have an active and updated long-term agriculture development strategy. In addition, an embedded framework for RTCs is almost nonexistent in the broad policy documents, limiting Government’s ability to allocate resources for the RTC sub-sector. The sub-sectorial policy could promote research on alternative climate resilient, high yields and market preference varieties. Farmers could be supported with seeds, production & trade infrastructure, updated information on best practice methods and market opportunities. Often times, an exporter that sources directly from farmers can help in marketing and trade of the RTCs. However, there should be a regulatory authority to ensure price stability, quality assurance and consistency of supply. Land tenure issues in many countries remain unsolved and this also limits private sector investment and confidence in TRC and indeed in agriculture related activities in general.

### Value Chain Analysis

A Value Chain Analysis (VCA) identifies ways to (i) create value for connected agents and various stakeholders (ii) maximize value addition (GDP) from production and trade and (iii) inform the likely incomes and welfare effects of linking back and forth in the supply chain. While supply chains model the strategic placement and role of various stakeholders in the procurement process, VCAs describe “who gets what” from producing the component(s) leading to final consumption. The latter is therefore an element of the broader supply chain.

The VCA gets complicated when products move from its raw to processed form leading to the production of an entirely different output that has little or no resemblance to the original product. In addition, such a change could also yield non-marketable bi-products. Thus, without detailed information about input-output ratios and costs including those for transportation, utilities and intermediation, VCAs could become highly complicated and meaningless. Primal calculations could produce misleading information and therefore in the absence of detailed disaggregate data; VCAs must be treated with a high degree of caution, SPC (2014).

Because farmers do not engage in value creation (except only at the primary stage) their incomes and livelihoods remain poor. In addition, they are ill-informed about the changes in the market tastes and preferences. In reality, VCAs show that the up-take of primary producers is minimal. VCAs must be consumer driven, i.e. farmers must produce along the demand
curve of consumers. However, in the Pacific Islands, many traditional farmers fail to understand this concept but endeavor to minimize the post-harvest loss by off-loading outputs at prices below the market price. Rural and remote farmers cannot deny the inter-mediators who are an important link between the farmers and markets. No doubt, this minimizes some transaction costs but consequently, imposes a wedge between the farm gate and market prices, even though the real value-addition in intermediation is negligible.

Countries have responded differently to these important challenges. Samoa, for example, which had lost its export market for Taro has now invested in developing varieties that are more resilient. Kiribati and Tuvalu have ventured into Giant Swamp Taro to deal with adverse climatic conditions. Fiji commercialized Taro production but agro-processing success of Cassava is limited due to supply constraints. Alternative uses of cassava in Fiji and Vanuatu have been abandoned due to high cost and food security issues. Nevertheless, there is a huge potential for all the PICs to trade RTCs in large scale globally and create additional value by investing into agro-processing.

The trade of RTCs and agricultural products require some form of regulation especially when the two prices vary immensely. Establishment of better networks and communications systems can help minimize the currently present information asymmetry. Climate-smart and organic agriculture can help farmers gain a higher share in the VCAs as they seem to be the answers to the climate-induced low productivity and trade issues in agriculture, SNV-NDO (2013) and FAO (2009). It might also be good response strategies for world-wide farmers’ outcry of low incomes in value chains.

A few important issues in VCAs related to the PICs need attention. First, micro-level data, their accuracy, consistency and availability are questionable. Farm records are incomplete due to poor record keeping. Even the National Statistic Offices do not have up-to-date micro-level agricultural database required for a serious VCA. Thus, with limitations in data, VCAs remain incomplete and or not pragmatic. Second, with non-standardized product quality, VCAs are harder to implement leaving the results of alternative systems and products incomparable. Structural changes such as off-season production and prolonged bad weather distort VCAs making them less valid. Grading of products, quality control mechanisms and quality assurance can help somewhat, but these could be meaningless with intermit or low supply response form eh industry. Malpractice in farms and factories, such as use of low quality inputs in agro-processing, undetected use of chemicals despite organic certification, and creating barriers to market information could also result in inaccurate VCAs. A useful country list of organic products and their certification is in FAO (2009).

In addition, fair trade considerations continue to seek answers to “who gets what”, compared to, “who produces what”. This questions the rationality of share-size distribution. Thus, the VCAs where agro-processing are involved could give a misleading picture to the farmers. In addition, the GMOs that can raise quantitative efficiency may not raise consumer value (at least in well-informed markets), raises doubts on the VCAs conducted on these products, especially for cross-product or cross farming system comparisons.

Finally, most of the agricultural research institutes in the region do not have expertise to conduct VCAs. This is partly due to the limited research funding and weak research & publications culture in the Pacific. Therefore, there is a need to establish detailed VCAs on almost all major commercial agricultural products because those that are available are either incomplete or require re-examination.

Conclusion

This paper provides an overview of Pacific agriculture on RTCs and discusses important issues surrounding value chains analysis. It suggests that given the problems in RTCs production and trade, adequate support from Government, donor and research institutions are needed to develop production and marketing infrastructure as well as market information. It also suggests that value chain analysis must be conducted afresh to attract new investment and retain farmers and other stakeholders in the industry. However, quality disaggregated data, technical expertise and high quality industry specific research are the key to successful RTC industry in PICs.

Future Directions

RTCs need adequate attention in the PICs’ agriculture development policies. To increase farm productivity, food security and manage non-communicable diseases, the region needs to re-consider the development of RTCs sub-sector more comprehensively. Adequate
resources and funding should be made available for the private sector to innovate and link with the markets within and outside the region. Agro-processing could also be encouraged and facilitated to accelerate value addition and profitability. Together with the development of organic and climate-smart agriculture, supply consistency and quality assurance and certification, greater value can be realized in the RTCs and indeed in the broader agricultural sector in the Pacific Islands.
INTRODUCTION

This paper discusses the developments in Fiji’s agriculture (especially the RTC sub-sector) and the Fiji Agriculture Sector Policy. The conclusions suggest that key issues facing the RTC sub-sector require long-term commitments, self-sufficiency, highly competitive and dynamically productive agriculture sector in the country.

Data and industry experience show that technical efficiency of RTC in Fiji is quite high as they are traditional crops developed over long time periods. Most of the RTC production is intended for domestic consumption, but exports of RTCs have increased in the last two decades. Fiji’s export market is highly competitive with India, Vietnam and Ecuador providing intense competition. In addition, barriers to fresh produce exports resulting from high cost of compliance with the strict quarantine and bio-security standards imposed by Fiji’s trading partners limit export potential for fresh produce. As a result, investment in agro-processing and value adding in the production of flour, chips, washed and peeled, snap frozen and ready-to-eat products will help overcome market access and facilitate an increase in value of exports. Value adding of ginger has proven successful, as has the production of Taro and Cassava chips. Fiji’s large scale production of flour and ready to eat vegetables has the potential to significantly reduce import dependence on grains and potatoes.

The commercial production of taro (major root crop) dates back to the 1950s in the response to an increase in urban market demand, particularly the Nausori-Suva corridor. It became an exportable crop in 1994 due to the Taro Leaf Blight in Samoa which at that time was the major exporter to the New Zealand market. Fiji’s Taro exports have grown over the years and have become the second largest agricultural export earner. The Taro production areas are spread all over Fiji, but a significant share of production comes from the Central division. However, 70% of the export quantity comes from Taveuni (in the Northern division). Fiji’s Taro over the past years has mainly been exported to New Zealand capturing about 65% of the market and the remainder to Australia and the USA.

Despite the identified market opportunities, the Pacific Island Countries have not been part of the global horticulture revolution. Fiji is finally starting to prove an exception to the rule, with horticultural exports becoming a lead growth sector. This coincides with the slowing down of the sugar industry in Fiji and where the identification of diversification towards other export commodities and rural livelihood opportunities is urgently required for creating a buffer against the declining sugar industry. Together with other crops, RTCs have a very prominent part to play in its expansion in the sugarcane growing areas where a significant rural population is located.

Challenges in Fiji’s Agriculture

Agriculture, including sugar, non-sugar, livestock and subsistence farming, remains vital for Fiji. It provides food and livelihood security, promotes community development, generates income for approximately 65% of Fiji’s population, and earns foreign exchange. However, the contribution of agriculture to GDP has decreased from 12.3% in 2001 to 8.2% in 2010. This decline is often contributed to a combination of factors, such as; minimal private investment, inadequate infrastructure, marketing deficiencies and soaring production cost. In addition the predominance of small farms operating on less than one hectare of land and low levels of mechanization of production has left the productivity of the agriculture sector languish relative to other sectors.

The competitiveness of Fiji’s traditional export commodities (sugar, fish, coconut oil
and copra; and selected fruits and vegetables) is also declining. As a result, imports of food products are on the rise. In addition, the shrinking contribution of sugar sector is one of the main factors for the decline in agriculture. Indeed total area under sugarcane has decreased from 112,192 hectares in 1991 to 57,177 hectares in 2009, as farmers sought to diversify into other crops or gave-up sugarcane at the expiry of their leases. The real issue is: How to increase productivity in Fiji agriculture sector?

One possible answer is research and technology diffusion which can be essential in building competitiveness in farming systems. More emphasis on research and extension is needed to empower farmers with the technologies and skills required to diversify into higher-value crops and to boost productivity. It is critical, therefore, to encourage the establishment of demand-driven input supply services to facilitate private sector development and diversification. Establishing the right model for service delivery and incentives are therefore critical to increasing productivity. Providing producers with the right incentives is also important. Despite difficulties competing in export markets, a lot of opportunities exist in the growing urban domestic market of traditional and value-added food products. This is supplemented further by the growth of the tourism industry.

These are opportunities available to Fiji’s agricultural producers. A significant market opportunity lies in the production of feedstock for biofuels and animal feeds to reduce the country’s feed and fuel importation bill. Facilitating increased investment from the private sector is critical to encourage both technology transfer and adoption of modern inputs required to be competitive. This requires the adoption of a new approach by the Government - a movement from direct service delivery, to one of partnership with the private sector. It encourages the Government to play a more strategic role in identifying opportunities and working with the private sector to implement policies and regulatory changes. It also requires the introduction of innovative funding models and business models in order to attract the dynamism of the private sector, into achieving a public vision.

A firm decision to embrace forward-looking development agenda is needed. On this basis, Fiji has developed a ‘Fiji 2020: Agriculture sector development agenda’ to provide a framework for utilizing the country’s agriculture resources more productively through the adoption of improved production and processing technologies, and the implementation of and financing and management strategies.

**Fiji’s Agriculture Policy**

The Government of Fiji has undertaken a number of agriculture sector policy stances since independence. As a result, there has been significant experience gained in taking the necessary steps to develop and implement a long-term and inclusive national development agenda for agriculture. The Fiji agriculture sector needs to strategically and systematically improve its organizational and technical capabilities in order to face the challenges of the 21st century. It is important we must capitalize upon the strengths of our traditional agriculture in addressing the challenges for the future.

The Fiji Agriculture Development Agenda 2020 provides a framework for long-term modernization of Fiji’s agriculture. This framework aims at providing the right incentives to stakeholders both within our local farming communities, as well as large agro-processors and enterprises. It aims at attracting higher domestic and international investment by creating the enabling conditions for growth in the sector. It also identifies a number of methods for improving the efficiency of public and private service delivery, incorporating the lessons of global innovations and technical achievements. Its key objectives include sustainability of national food security and rural livelihoods, which it intends to achieve through a more diversified and environmentally sustainable agriculture sector.

A number of key long-term strategic challenges are identified, including:

- Increased food import dependence;
- Threats of more frequent natural disasters due to climate change;
- Decline in the competitiveness of Fiji’s traditional export sector,
- Fall in commodity prices and productivity of small holder farming;
- A rise in the dependence on imported sources of fuel.

The strategic directions required to achieving the stated objectives can be summarised as follows: First, the Government of Fiji through the Ministry of Agriculture will establish Rural Transformation Centres. These will support improvement in the efficiency of extension information delivery as well as improved access.
to planting material and farm machinery, thus providing a ‘one stop shop’ of rural agricultural services. The Government would enter into public-private partnerships through which it will invest in the construction of physical infrastructure, while the private sector would be invited to operate the business of retailing seeds, feeds, fertilizers, farming tools and farm machinery rental, as well as training marketing and farm management.

The Government will deliver complementary agricultural extension training and capacity building services using the Farmer Field School model. This will focus on adoption of simple technologies to improve productivity, and commercialization of smallholder agriculture. Additionally, it will focus on adopting technologies to reduce the dependence on chemical fertilizers. In addition, it will assist rural households to diversify into crops matching the soil capability by using the existing soil mapping and testing technologies. Facilitating the adoption of improved varieties of fruit and vegetable crops, will help improve household incomes by increasing yields, pest and disease resistance, counteracting natural disaster, and improving marketing potential. On poorer soils and dry regions, farmers will be assisted to diversify into production of grains and pulses for animal feed production. The Research and Extension division will establish closer links with the local Universities to increase the impact of field research and help improve the curriculum to increase the number of trained agricultural research and extension officers available to support the Centres. Closer linkages will also be forged with the high schools to ensure that modern farming techniques and farming as a business are included in the school curriculum.

Secondly, the Government will facilitate clustering of commercial agricultural processing and manufacturing into up to three Food Parks located in the strategic geographic areas close to urban markets and export infrastructure. The clustering of complementary agricultural activities in Food Parks will be to reduce the transport and handling costs inherent in aggregating and storing agricultural produce, agro-processing, food manufacturing and marketing. The Government will encourage private sector investment in designated Food Park zones by ensuring improved transport infrastructure, tax and tariff reliefs and access to competitive development finance.

The two target industries are biofuel processing and local production of animal feed. Given the existing cane and grain milling infrastructure in the country and the current and potential scale of production of feedstock, both industries will provide significant domestic market opportunities for agricultural producers in the country. In addition, these initiatives would significantly reduce Fiji’s import dependence on the two critical areas affecting agriculture in Fiji.

This strategy also targets opportunities to add value to the production of fruits and vegetable into fruit juices, purees, pickles and jams, complemented by the production of vegetable paste and sauces. Given the quarantine and freight cost barriers to export of fresh produce, attracting investment into value-adding of local food products would provide a boom to export industries and increase the value of domestic produce.

Thirdly, the Ministry of Agriculture will work with key stakeholders across the Government and the private sector, to identify innovative business models, funding models and regulatory changes required to attract sufficient investment in the agriculture sector. For instance, the Ministry will oversee the establishment of a new investment fund for co-financing through the PPP arrangement to offer concessional loans to commercial banks, in order to enable them provide cheaper finance to the agriculture sector. Second, the establishment of an inclusive Food Policy Council to identify key policy and regulatory changes required to improve the enabling conditions for agriculture sector growth. The Council will be commissioned to produce feasibility studies in order to establish the costs and benefits of undertaking targeted reforms, and funding of infrastructure involved in establishing Food Parks and Rural Transformation Centres. Income and consumption tax relief and tax holidays for agriculture sector investors will also be explored by the Council.

Tariff reductions on key agricultural inputs, as well as increased tariffs and consumption taxes on competing imported products, is critical to improving the competitiveness in agriculture. The Council will need to focus on legal and administrative issues surrounding the leasing of customary land, and the impact on the use of land as collateral in agricultural lending. It will also need to establish a Sovereign Risk Facility capable of matching the level of exposure of the private sector in the implementation of an Agricultural Insurance Scheme.

Finally, in order to support the implementation of the Fiji 2020 Agenda, project
planning and policy formulation capacity of the Ministry of Agriculture needs to be strengthened. Under this new Agenda, the Ministry will be central to facilitating private sector investment in the sector, complemented by secondary focus on facilitating smallholder adoption of improved production technologies. In order to support the new focus, the Ministry will increase project planning, implementation and monitoring capacity of its staff through increased training on data analysis and policy analysis techniques. This will be supported by improved agricultural data gathering and dissemination. The publication and communication of regular analytical reports on production and marketing trends, and analysing the impact of policy and regulatory changes on the performance of the agriculture sector, must be central to its new set of responsibilities.

Conclusions

This chapter provides a glimpse of Fiji’s Agriculture sector policy and the key strategic direction of the Ministry of Agriculture in Fiji. This could be a useful planning framework for agriculture development in other PICs.

Future Directions

Fiji’s development plan for its agriculture sector sets a broad policy agenda and key strategies for agricultural development. Although it is intended in the plan, the development of RTCs requires urgent attention. Given that some of the key issues facing the RTC sub-sector require a long-term commitment, the policy aims to clarify the future directions of the Government, which point to self-sufficiency, improved competitive for a dynamic agriculture sector. Important initiatives include public private partnerships, training and education, infrastructure, trade and capacity development to support agriculture sector growth, productivity income generation and improved rural livelihoods.
Maximizing Value Chains of Cassava Production in Fiji

Savenaca Cuquma, Ilisoni Banuve and Filimoni Rayawa

OVERVIEW

This paper discusses the major issues of raising productivity and maximizing value chain in Cassava production in Fiji. Whilst Taro, Yams, Sweet Potatoes and other root crops are commonly grown, Cassava is cultivated for domestic consumption, food processing and for export purposes. It has many more possibilities but these are undermined by the processing technology, right investment and food security issues. We are of the view that if Cassava processing is integrated with production of renewable energy, value-addition and importance of Cassava can be much more viable.

This paper is structured as follows: Following the brief introduction below, Sections 3 and 4 discuss the important issues on Cassava production and for maximizing its value chain. Section 5 states the conclusions followed by 6 which summarizes with the future directions.

INTRODUCTION

Cassava, a perennial plant which is almost exclusively propagated from stem cuttings, is cultivated throughout Fiji. It is one of the most important staple root crop. The annual production of cassava is around 70,000 tonnes. In 2013, Fiji recorded 94,000 tonnes yield of Cassava (FAO Statistics) and produced an efficiency level of 13.4 tonnes per hectare. The Central Division is the largest supplier producing almost 72% of Cassava due to the strong demand from the local markets in the big urban centers. Urban boundaries of Lami, Suva and Nausori corridor hosts about 57% of all urban population in Fiji.

Domestically, Cassava is mostly consumed in boiled/baked form, although there are other uses. Agro-processing is a more recent phenomenon. Frozen Cassava as well as selected Cassava products are exported from Fiji. Over the past 10 years, cassava exports hovered around 2,000 tonnes per annum with almost 50% exported to New Zealand. The remainder is exported to Australia, USA, Canada, France, Korea, Nauru, Hawai, Tuvalu, Western Samoa and Kiribati. Cassava exported in frozen form earns about F$2.8m in export revenue annually. Fiji ranks 51 in the global production scale and accounts for an insignificant share of the world market. Raw cassava exports are hard because the tubers deteriorate in quality very easily.

Fiji is a promising location for Cassava-related industries because of its suitability to the climate and the scale of Cassava cultivation. The Fiji Government is inviting local and foreign investors to establish Cassava processing industries whereby investors have the option to engage in the growing and processing of Cassava, or to buy the crop from local farmers and concentrate only on processing. An alternative development proposal to turn Cassava into ethanol was also introduced, but was shelved due to its risks to food security.

Currently, Fiji uses local cassava as freshly prepared food animal feed, for Cassava chip, flour and starch production. Additionally, Cassava can be processed into a number of other products for segmented markets as high value product. This could open vast agro-processing options and significant export possibilities.

Some of the ways in which Cassava could contribute more significantly to Fiji’s production economy and agriculture are, better use of Cassava to develop new types of agro-processed products, feed production for livestock and poultry and promoting Cassava as a “healthy snack” raw material. Starch, syrup and ethanol production could be revisited,
especially in the dry and less fertile soils of the Western division, where large-scale cassava farming could be developed.

**Challenge in Value Chains for Cassava**

Cassava is produced in all the 4 Divisions of Fiji; however, as stated already, most of the production comes from the Central Division. The total Cassava production in Fiji picked up sharply in 2009 following an anticipated demand from new processing ventures, which failed to materialise. The introduction of the New Guinea and Nadalei varieties has expanded the production of cassava extensively in the Western division. A snapshot of Cassava supply in the period 2008-2010 is presented in Table 1.

### Table 1.0 Root Crops Production at Division Level

<table>
<thead>
<tr>
<th></th>
<th>Northern</th>
<th>Central</th>
<th>Eastern</th>
<th>Western</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>12770</td>
<td>2652</td>
<td>1943</td>
<td>3061</td>
<td>20,426</td>
</tr>
<tr>
<td>2009</td>
<td>9030</td>
<td>21022</td>
<td>2124</td>
<td>4425</td>
<td>36,601</td>
</tr>
<tr>
<td>2010</td>
<td>8062</td>
<td>6213</td>
<td>1943</td>
<td>1300</td>
<td>17,518</td>
</tr>
</tbody>
</table>

Data show that cassava production has declined below its 2008 levels after a dramatic pick-up in 2009. Table 2 shows the prominence of the major RTC’s of Fiji in the period 2008-2012. In the more recent period, the scale of Cassava production has increased, details can only be established with a more recent agriculture census data, which is not at our disposal.

### Table 2.0 Important Root Crops Production in Fiji (Tonnes)

<table>
<thead>
<tr>
<th>Crops</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava</td>
<td>55,773</td>
<td>42,332</td>
<td>51,690</td>
<td>69,910</td>
<td>96,778</td>
</tr>
<tr>
<td>Taro</td>
<td>74,009</td>
<td>69,863</td>
<td>60,283</td>
<td>67,179</td>
<td>82,145</td>
</tr>
<tr>
<td>Xanthosoma</td>
<td>3,683</td>
<td>3,327</td>
<td>1,536</td>
<td>3,495</td>
<td>4,164</td>
</tr>
<tr>
<td>D. Esculenta</td>
<td>1,102</td>
<td>203</td>
<td>472.8</td>
<td>739</td>
<td>486</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>4,611</td>
<td>4,894</td>
<td>7,464</td>
<td>8,635</td>
<td>9,402</td>
</tr>
<tr>
<td>Potatoes</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>521</td>
<td>854</td>
</tr>
<tr>
<td>D. Nummularia</td>
<td>854</td>
<td>380</td>
<td>380</td>
<td>1,211</td>
<td>1,161</td>
</tr>
<tr>
<td>Via</td>
<td>60</td>
<td>0</td>
<td>0</td>
<td>220</td>
<td>185</td>
</tr>
</tbody>
</table>
Consequently, due to limited information on production, trade, trade margins and costs, it is hard to do a detailed value chain analysis. However, there are a number of ways in which economic value in Cassava are realised in Fiji. At the subsistence level, it contributes to production for family or personal use. This is a huge cost saving, with almost no implications for financial costs, trade margins or post-harvest and transitional loss involved with trade. Surplus from such production as well as from semi-commercial production is off-loaded to local formal and informal market at $5 or $10 per bundle. Of course middleman gets involved if farmers may choose not to engage in market retail.

Subsistence production of Cassava is most common in Fiji. Semi-subistence farmers grow Cassava in addition to other marketable produce like fruits and vegetables, poultry and livestock. For these producers, Cassava supplements their consumption, and more importantly, other main agricultural activity. A third modality is commercial production where farmers produce the tubers for industrial use, food processing or exports. This is a recent and fast growing industry which has intensified production, investment and use of Cassava in Fiji. Domestic commercial production is targeted to a selected range of food processors in Fiji. External trade of Cassava happens via well-connected processors and exports, who deal with quality, pricing, bio-security and export risk issues. The major constraint in maximising value chain in Cassava is the maintenance of consistence supply, which is strongly linked to the lack of large scale production. In addition, market signals are weak and intermittent. These restrict large scale investment and production, although farmers are slowly penetrating the external demand and trade opportunities.

The following identify other issues in maximising value chain analysis of Cassava industry in Fiji:

- Need to provide information on supply, bio-security and marketing opportunities more widely to farmers.
- Farmer profiling and establishment of farmers association to better link farmers, processors and importers.
- Enhance networking between researchers, extension staff, farmers, middlemen, exporters and processors.
- Regulation and control of Cassava prices through a price control agency.
- Government initiatives to promote more Cassava production to ensure domestic food security and higher exports.
- Trade infrastructure for facilitating Cassava and other RTCs trade must be developed. This may include processing plants, package facilities etc.
- Proper education, better training and support to the key players in the industry.
- Minimize the use of intermediaries as far as possible because often times, for this high perishable product, farmers loose huge incomes to these agents.

Maximizing Value Chains

Below are the key strategies that we think could revamp the agricultural sector in Fiji. This could go a long way to help maximize value chains and improve Cassava production. Interested readers may resort to other papers on strategies for improving general agricultural productivity in Fiji.

First, there is an urgent need for the industry to focus some large scale projects on Cassava production, possibly through public-private partnership. Second, research on Cassava and RTCs in general must consider advancements in information and communications technology. It must promote advanced scientific knowledge to boost productivity in cultivation of Cassava. Third, the research agenda of academic and research institutions must be inclusive to the needs of agriculture sector and its industrial partners. Priority areas of research from a practitioner’s point of view include, postharvest handling, new agro-processed food product development, climate-smart agricultural practices, soil and water management, mechanization, crop management, crop protection, agribusiness and use of information and communications technology.

Forth, the Research Division of the Ministry of agriculture must establish and maintain reliable database to avoid possible repetition and duplication of research work conducted by other institutions. The research council, through its technical secretariat in the MOA, must prepare the national agriculture research agenda based on
Fifth, there is a need to develop a longer-term national RTC development plan in Fiji which is forward looking and approved by the Food Policy Council. This must be vested within the new national agriculture policy of Fiji.

Sixth, private sector must be involved possibly through aggressive marketing, competition and development of agro-processing industry. The industrial development must provide tangible incentives to farmers to increase high quality produce.

Further, with assistance from the Ministry and its partner institutions, innovative business models of different scales must be developed and experimented. Finally, international trade and marketing including the use of market intelligence, promotional strategies, and e-marketing must be encouraged.

These strategies will promote RTCs in Fiji and beyond because many other PICs depend on how Fiji develops its agriculture and industrial sectors. In addition, they may source agriculture materials such as seeds, livestock, including knowledge and expertise from Fiji, which seems to be doing regionally better in agriculture.

Conclusion

In Fiji, cassava will remain important due to its significance in social, cultural and traditional events. It is one of the mainstays of Fiji’s economy because of its heavy use in diets and more recently, an increasingly important source for agro-processed food stocks. The determination, drive and identification of key players in the industry, the Government and other stakeholders are important for improving its productivity and potential for international trade. Increasingly farmers are looking for markets for fresh cassava exports outside Fiji. Cassava also remains strategically important because of its ability to adapt to lower quality, less fertile and dry land. This could be a real opportunity for marginalized land in the sugar sector.

To maximize value chains in Cassava trade, adequate research and information flow are important. Priority areas of development include innovative research, postharvest handling, food processing, crop protection, and agribusiness management and communications and networking infrastructure. These will also improve Fiji’s economic potential in other important RTCS exported from the country.

Future Directions

Like Taro, Cassava will remain a staple food for Fiji. It is strategically important for exports, although international markets are less exploited for Cassava. To maximize value chains, large scale production, agro-processing and marketing of Fiji cassava are important. With rural electrification stretching to remote places of our islands, both Dalo and cassava productivity will kick-start at a much higher levels, spinning-off to the external trade sector.
Farmers’ Perspective on Maximizing Value Chains in Taro Exports in Fiji

James Swamy, Shyam Nand and Aiyub Hussein

OVERVIEW

Taro (domestically referred to as Dalo) is an important staple root crop for Fiji. It is mostly traded and consumed domestically but is also exported to overseas countries. Commercial production of Taro dates back to the late 1950’s but it has become a primary export commodity since the early 2000. The Taro Leaf Blight which badly affected Samoa’s Taro exports to New Zealand around that time also contributed to the boost in Fijian exports and market potential. Since then, Fiji has become a major exporter to New Zealand market and the Fijian Taro exports have grown rapidly over the years.

With many challenges identified in this paper, the key issues for maximizing value chains include provision of market information, quality control and price regulation. In the short-term, better education on smart and commercial farming and the availability of input supply need attention. In the longer-term, Fiji must diversify into producing high-value agro-products and improve farming and trade infrastructure for the agriculture sector. Taro sub-sector needs attention because it has greater potential in the export market. In addition, agro-processing of Taro products can be expanded.

INTRODUCTION

Among the root crops in Fiji, Taro ranks second only to Cassava in terms of production volumes and hectares cultivated. For several decades now, Taro has been second to Ginger in export earnings, but since the mid-1990s, it has become the largest foreign exchange earner for Fiji in the RTC category. With growing international demand from Australia, USA and Asian economies, production of Taro in the period 2000-2010 has responded favorably, although there were declines in 2007, 2010. These were due to weather related events.

Currently, annual Taro production is just around 100,000 tonnes and the annual exports of Fijian taro is in around 10,000 to 15,000 tonnes. Taro is grown in all the four divisions of Fiji but most of it comes from Central, Eastern and other wet regions where rainfall exceeds 2500mm per annum. About 70% of exportable Taro comes from Taveuni. This region has become an important regional connection to the major markets in Fiji and beyond.

Farmers feel that small-holder export costs, quarantine import protocols and their application are the major factor determining their ability to maintain and expand the Taro export market. With the expansion and deepening of New Zealand and USA (including Hawaiian) markets, economic potential of commercial farmers in Fiji has grown significantly. A study by the SPC and the EU argues that Taro exports have the potential to more than double its value if it is can be made more competitive in terms of price and quality. The study also notes that increased Taro exports would result in significant benefits for large numbers of low-income rural population connected to the growing Taro export industry.

Taro cultivation is occurring on both flat alluvial lands as well as on fertile hillside slopes. Taro plantation also provides shade for young kava and selected vegetable plants in a multi-cropping farming system around the country. Fiji Kava is also a major crop exported to the region and beyond. Mechanization is used in cultivation of Taro on the flat land, but farming on slopes relies mainly on manual operations and the use of different fertilizers. Taro beetle and Leaf Hopper are the major pest problems although Fiji is free from the Taro Leaf Blight.
Blight and other serious diseases.

With the increase in demand for food crops resulting from growth in trade, rise in income and population, the practice of shifting cultivation is fast dis-appearing in favor of intensive Taro production. The practice of shifting cultivation is still being followed where less dense forest land would be cleared and direct holes are made using a planning stick of about 1.5 m long. In the first year, Taro would be the main crop, but by the second and third years, an intercropping pattern would have developed depending on land farming interest, income potential and suitability of weather. Normally, the land would be fallowed after two to three years of cropping. In some areas if the climate and vegetation allow, regeneration of forest species could proceed at a rapid rate. Consequently, soil nutrient replenishment by natural means could be achieved in a few years, and the land could then be replanted. There are, however, certain areas where forest species are either slow to regenerate or never recover at all. These run the risk of negative environmental effects.

The use of machinery and innovative farming methods are mostly due to commercial farming. In this system, Taro is planted in rotation with other crops (Ginger and or Kava) mostly with intensive labor or by using selected machinery. However, the frequent rotation of yield for commercial cultivation has led to soil and nutrient loss through soil aeration and erosion. This can potentially undermine taro farm productivity. Crop rotation and other better farm management practices such as fallowing and using manure can help control soil loss, maintain soil quality and prevent diseases to some extent. Taro corms are marketed in fresh form locally and abroad with petioles attached. Locally, this assists in the distribution of species since top sets are used as planting material. Quarantine requires that Taro corms for export be cleaned, with approximately 5cm of petiole base remaining. The harvested corm could be kept for about a week or two, depending on post-harvest handling, treatment and corm moisture content.

In Fiji, the per capita annual consumption of Taro is just about 100kg slightly over Cassava consumption which hit its peak of about 115 kg per person in 2012. In general, average per capita consumption of the two is almost comparable -around 80kg per person per annum. Annual consumption of yams and sweet potatoes are much lower at around 40-30 kg per person, respectively. Hone (2004) found that overtime; Fijians have reduced consumption of Taro in favor of high calorie food such as rice and flour. With relatively faster lifestyle coupled with more food choices, the study found that preparation problems and time constraints were the key reasons for the decline in traditional food crops like Taro. In addition, root crops such as Taro, Yams and Kumala were consumed less frequently because they were perceived to offer poor value for money.

The 2007 Fiji’s Food Balance Sheet showed that the daily per capita food intake by an average Fijian was 3411 thousand calories (kcal) which is about 50% higher than the recommended daily intake. It also reported that an average Fijian consumes 56kg of rice; 68 kg of cassava and 56 kg of Taro annually. However because root crops have a lower caloric value than rice or wheat, it is relatively costly to stretch the low incomes on root crops. In addition, with high urban concentration (well over 50%), and land lease problems, the majority of population do not produce their own crop but depend on local supply in the markets and cheap imports of substitute food.

Competing crops for Taro farmers are vegetables, Kava and Cassava, although the latter could be grown on less fertile poor soils which are low in nutrients, humus and have low water holding capacity. Cassava is more agile and a common food crop choice for the indigenous population. It is also used for pig and livestock feed. For the farmers in Taveuni, Cassava would be the next major export product competing with Taro when electricity and processing infrastructure get developed. Apart from the Taro corms, its leaves are used and sold in the domestic market. The Fijian population has alternative uses of leaves (in food preparation as well as a substitute food). Similarly, Cassava and Kumala leaves are consumed and exported as to major markets as well.

Maximizing Value Chains

Value chains in RTCs can be easily maximised provided that the following factors are adequately addressed. First, relevant agriculture infrastructure seems to be the major problem for a lot of farmers in Taveuni or in other areas connected with Taro farming. This escalates the production and trade costs. Second, inadequacy of access roads that link to the major markets is another big problem. In Taveuni, some farmers use transportation modalities that increase the post-harvest losses. Where exporters and
middleman can access the farms, post-harvest losses and other costs are minimised. However the farm gate price received by the farmers can be highly volatile when there are limited exporters, an oversupply of produce, natural disasters or an unplanned planting schedule that yield an excessive crop.

The value-chains are also compromised because farmers lack critical information regarding market dynamics, potential and new markets, weather patterns and on natural disasters to plan their production ahead of time. The other major problem is security of land tenure. Whilst land leases are expiring, farmers engage with informal lease contracts that are not secure. This does not protect the interest of either the farmers or the landowner(s). In addition, practical knowledge on good farming practices is also lacking in the community. For example, premature harvesting leads to higher reject rate and less Taro suckers being re-produced. This also yields low quality Taro which is further compromised by poor post-harvest handling. Training on these areas will improve value and interest of farmers engaged with Taro production.

We recommend that quality control and standardisation of Taro produce are very important to maintain and develop Fiji’s existing market. Often, short and intermittent supply discourages important importers, reflecting loss of market share and future trade and income potential. Another important challenge in maximising value chains is bio-security issues as they have become important barriers to trade. Farmers need to be educated on what these are and how to deal with the bio-security risks.

Against this background, a few key strategies can be implemented in the short-term. These include upgrading of rural transformation Centres and farmer’s field schools. These will be important training and knowledge infusion facilities. Farming infrastructures which include, farm access roads, electricity, ports, jetties, cooler system and collection centres must also be developed and or upgraded. There is a clear need to improve the delivery of farm support services, hopefully from research institutes and the Ministry of Agriculture. These would include research, training and extension services, value-adding and marketing information, agriculture statistics, developments in bio-security laws, credit facilities etc. In addition, a commercial nursery will minimise defects in genetic materials and a national Root Crops Council may help in improving the farmer’s voice.

In the longer term, farmers must diversify agricultural production to include new markets and high-value niche and organic crops. Better ways of production, quality assurance, connecting and networking could be explored to penetrate high-earned markets in the USA and the European region. Research institutes and training providers must work together with the farmers to increase farm productivity and develop more resilient high-yielding market friendly varieties.

**Conclusion**

Taro production and export must be promoted from Fiji, not only from Taveuni, but also from the other areas. In order to sustain this industry, there is a need to create value along the value chain process. This will prove useful if the identified challenges can be minimized by diligently address the important ones. The key strategies must help improve support services, investment security for farmers, promote trade of RTCs. A better and more supporting RTC policy must be drafted and implemented to help this high impact industry.

**Future Directions**

To maximize value chains in Taro production from remote communities in Fiji, the stakeholders need to improve information, networking, transport infrastructure, trade and research links. Some of the major post-harvest problems should be addressed carefully. Education and training, together with security of investment must be provided. A commercial nursery will help supply disease-free planning material to develop greater potential for the Taro industry. Unless these are forthcoming, equitable values anywhere along the chain, cannot be realized.
Maximizing Value Chains in Root and Tuber Crops of Cook Islands

Torotoro Junior Piti

OVERVIEW

This paper looks at the important issues in Root and Tuber Crops (RTCs) in the Cook Islands. It suggests how the value chain in this sub-sector can be maximized, although the scale of production of most of the RTCs is still at subsistence level. In the Cook Islands, Taro and Cassava remain the most important crops for domestic consumption as well as for exports.

The Cook Islands group consists of 15 small islands divided into major 2 groups. The Southern Group has 8 small volcanic islands whilst there are 7 Atoll Islands in the North region. Total land area of the Cook Islands is 238 square kilometers and it sustains a declining population of about 13,500 people of Polynesians origin. The population is declining significantly as the local population share special residency with New Zealand. The Island group is a hot-spot for international tourism with visitor arrivals averaging about 120,000 per annum. The boom in the tourism industry has created demand for accommodation, retail trade and agricultural produce. However, there is a need for better and improved varieties of RTCs that can serve the growing local demand and export market. In addition, production volumes need to increase significantly.

INTRODUCTION

Apart from Taro and Cassava, there are other root crops grown in the Cook Islands, but mostly for subsistence consumption and semi-commercial trade. These are grown mainly using raised bed and paddy systems. Swamp grown Taro is mostly enjoyed by the local population but its production is also declining. Sweetpotatoes (which is mostly a complementary root crop) is very important in the Southern parts of the Island. Sweet Potatoes reached its peak production level in 1993 (close to about 2200 tons), but currently the FAO statistics indicate that it is on a declining trend at around 600 tons. Cassava production which was as high as 4000 tons in the 1980 and early 1990s has also declined to 1200 tons in 2013.

Taro is a staple and important export crop for the country. In the early 1980’s its production started to increase, but the La Nina drift through the Asia Pacific caused serious dry spell which had significant negative impact of production. Consequently, the Ministry of Agriculture also discovered that wetland areas that were used to plant Taro was (1.63 m) higher than the water table which means wetland farming would reduce. This also implies that in the near future, drip irrigation could be a necessity to boost country’s agricultural output. Also, it implies that in order to maintain Taro production, adequate research, knowledge base and technology need to be developed. There is a clear need for more technical assistance and training on RTCs development for the Cook Islands. This will help sustain potential tourism and address the growing supply constraints. In response to funding requests, the donors and internal aid agencies have started providing technical assistance to develop local capacity.

The Government of the Cook Islands agrees that food security and climate change policies are to be harmonized and mutually supportive. In response, a Taro breeding program is now being introduces to breed Taro cultivar not only to maintain the Taro market but also to...
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withstand pest and disease and increase climate tolerance. The Ministry of Agriculture has already commenced a breeding programme aimed at producing capacity of more disease resistant varieties of Taro for the Cook Islands.

The exhibition of the improved Taro variety is made available to the population by farmers market and other exhibitions. Crop trials are also underway for Sweet Potatoes and other RTCs because the Government has realized that low-nutrient value imports are an important source of nutritional and dietary problems such as obesity and NCDs in the local population. In addition, a climate change adaptation program initiative of the SPC and the AusAid, over 5000 new hybrids of Taro has been have been produced for the Cook Islands.

Although the local production of most of the RTCs has declined, they still remain important in local diets. The decline in RTCs is substituted by an increase in importation of rice, flour and other processed food. This has led to a significant level of trade deficit and has heightened import dependence. Given the production base, data show that Cook Islands have serious food security issues. The average value of food production is about $115 per person, average food imports to merchandise export ratio was about 500% in 2010 (to total exports, 245% in 2013) and per capita food production has hardly changed in the period 2008 to 2012.

The Cook Islands have been exporting to two large markets (China and Japan), which account for 60% and 21% of their exports, respectively. One can only imagine the type of export potential that exists for the Cook Islands, if the scale of production could be increased. However, despite the importance of agriculture, it has remained semi-commercial and located mostly on the outer islands where farmers cannot find sizeable markets. Trade from these islands to the main commercial center in Rarotonga which is also the link to major export destinations such as tourism, a major contributor to the country’s GDP, can also generate specific demand for

Key Issues in Maximizing Value Chains

There are many issues in value chains which are affecting growers and also reducing production and yield of RTCs. For Taro specifically, there is not enough quality seedling available for large scale production to support local consumption and exports. Poor quality of seedlings also undermines any serious pest control initiatives. This can be improved by establishing more breeding sites and adequately supervised to ensure that the quality of crop is not compromised.

Second, a lot of training and education is required. Farm extension services must be expanded and each stakeholder must understand their specific role in the value chain. The training must be tailored to increase the knowledge base and build capacity in stakeholders (from seed producers-farmers right through the customers). In addition, value chain needs to be strengthened by improving the quality of products based on consumer preferences and volume of production.

Third, handling, packing, storing and transportation are related areas that need serious development. These should be improved to add value to the taro business. The Government, together with external assistance must set-up storage and processing units and finances the development of critical trade facilitation infrastructure to help other stakeholders connected with RTCs or broader the agriculture sector. This will go a long way to boost trade and availability of produce in the markets.

Forth, it is becoming increasingly important to carry out research and analyses on production, processing and trade of RTCs. Regional training and technical institutes have a lot to offer to develop the knowledge base of the Cook Islands. However, their direct engagement is very limited. Awareness program can also inform farmers of the latest development in research and marketing. In addition, the limited scale of agro-processing activities undermines high-value trade possibilities for the country. There is a huge potential to engage in public-private partnerships to develop agro-processing in RTCs.

Further, the Government can work with farmers to maximize yields and minimize risks in farming enterprise. The Government can also subsidize production inputs (such as machinery and fertilizers) and open the hire of Government’s farm implements and machinery at subsidized rates. The introduction of a new Material Exchange Program can potentially promote RTC production.

Tourism, a major contributor to the country’s GDP, can also generate specific demand for
producing good quality RTCs for the hotel industry. However, this link seems to be distorted currently. Supply consistency, competitive and high quality production are necessary to tap in the market more successfully. The Government must promote this integration more seriously.

Unless the production volume is expanded, there is only a limited range of things that can be done to promote the RTC sub-sector. However, for the Cook Islands economy, the entire agriculture sector must be developed more meaningfully. A potentially effective way of doing this would be to attract the former nationals of the country who are now residing in New Zealand, USA and Australia to invest and encourage the growth of the agriculture sector. The Government can form partnership ventures with these investors, including international food processors. Finally, the cost of utilities and doing business remains high in the country. If international investors can be attracted by other investment promotional policies (such as tax holidays, extended depreciation allowances etc.), this can off-set some of the cost of doing business in the country.

Conclusions

Further development of RTCs will be useful for the Cook Islands economy, not only to improve its food security but support economic growth and trade. The major challenges for the RTC sub-sector are low productivity, climate change, pests, diseases resilience, and improve quality of produce. To increase productivity in RTCs, the Cook Islands need to explore modern ideas, technical assistance and specialized training. Other issues such as the provision of seedlings, and farmer training in better agronomic practices also will help. This should be done as a wholesome intervention in the agriculture sector rather than just for the RTCs. The economy must capitalize its huge diaspora in public private partnerships for investment and establish meaningful links to the growing tourism sector for the expansion and deepening of its agriculture sector. This will also help deliver more local food of high nutritional value to domestic markets, which will help towards managing NCDs and dietary related problems.

Future Directions

The RTCs sector is strategically important for the Cook Islands and it has the potential to expand in the near future. In order to sustain its development, all stakeholders together with the international donors and development partners must help improve knowledge base, technical expertise, and agriculture extension and markets information.

As the sector grows, identification of new regional and international markets, improvement in farm productivity, trade efficiency, and compliance with market access requirements will contribute to more equitable and meaningful growth of the economy. To ensure that such initiatives benefit small producers and contributes to reduction of food price volatility, improves food security for the county and reduce food import bill, a multilevel and holistic market oriented approach should be applied.
Maximising Value Chains for Root and Tuber Crops in Tonga

Vunivesi Minoneti

OVERVIEW

Agriculture continues to remain important for the Tongan economy as it contributes between 40% to 50% of the country’s GDP and about 70% of its exports earnings. Just over 40% of employment in Tonga is based on agriculture sector activities and the data show that around two-thirds of Tongan households are involved in this sector, mainly for subsistence and home-use production. Of these, about 38% are engaged in subsistence agriculture for cash incomes, FAO (2009).

Coconut products (copra and oil), banana, squash, vegetable, vanilla beans, root crops kava and fish are the major agricultural export commodities for Tonga. Unfortunately, most of these have been on a declining trend over the years. In addition, large scale agriculture has not expanded in a manner one would expect, possibly due to low investment, lack of farm productivity and land lease problems. Marine products and the recently explored crude oil have some potential. There is a small plantation of forestry on one of its islands, but it is unlikely to reach a commercial size unless more land is allocated for this sub-sector.

Tonga has a total land area of 748 km² which supports a population of about 110,000 people. There are a few different modalities of land ownership but the limited amount of freehold land provides some basis for commercial agriculture. The out-migration of population has meant scarcity of farmers and lack of investment in farms. In addition, rise in urban concentration from outer islands and outskirts of capital city (Tonagtapu) has put a huge pressure on urban land. The city hosts almost 40% of the Tonga’s population. Whilst, this has increased the market size of local produce, it has also reduced crop production in rural and outer islands. Imports have tremendously increased to match the short-fall in domestic supply. Approximately 15% of all imports are food products.

Root and Tuber Crops (RTCs) remain important in the diets of Tongans despite penetration of imported rice and wheat. They also represent a measure of social status, prestige but more importantly, over 90% of the population depends on root crops for survival. Taro, Yams and Kumala are high demand RTCs in Tonga. Below is a summary of the major challenges in producing the RTCs and ways in which value chains in these crops could be maximized.

INTRODUCTION

For a small economy with limited technology, low connectivity to the world market, low production and selected export potential, over-dependence on agriculture, migrant remittances and foreign aid have been important strategies for economic development. Tonga ranks among the top countries of the world in terms of remittance and aid. With low rates of economic growth and limited trade surplus, the Government has had a difficult time promoting development welfare, incomes and livelihoods. The Agriculture Sector Strategy which is an important intervention mechanism for the Government, intends to boost productivity in agriculture and increase cash incomes for families. It is targeted to increase self-sufficiency in a number of food items, although Tonga is far from being self-sufficient in livestock, milk,
products, fruits & vegetables and other important staples such as rice and wheat. Yams are most important staple food for the Tongans, but wheat and rice are also consumed in high volumes. The locally grown RTCs have thus remained the basic staple crops for food security and social obligations. It has contributed about 18% by volume and 16% by value of total agriculture export between the periods, (2000 – 2013).

The RTC farming system in Tonga is very traditional which includes Yams, almost always intercropped with Giant Taro and a few plantains or bananas. Recently, Colocasia, maize, and other leafy vegetables are intercropped with the Yams. Large scale farms are only noticeable in the Government farms where the Ministry of Agriculture routines test procedures and crop trials of important and potentially commercial products. Nonetheless, Tonga hosts over 20 local varieties of Yams, 13 varieties of Cassava, 10 different types of Swamp Taro, 4 types of local and Giant Taros and 8 streams of Sweet Potatoes. Production in 2013 of Taro (Xanthosoma) was 1,111 tonnes, Taro (Colocasia) output was 1,008 tonnes and Giant Taro yield was 625 tonnes.

Tonga’s three major markets for root crops are New Zealand, Australia and the United States. For the five years (2009–2013), Cassava was the highest volume exported averaging around 2,158 tonnes per year whilst Yam exports (second highest) were 1,962 tonnes. Despite lower export volume, Yams had the highest export value averaging TOP$ 2.25m per year, followed by Cassava TOP$ 1.32m, Taro (Colocasia) TOP$ 1.24m, Taro (Xanthosoma) TOP$ 0.92m and Giant Taro TOP$ 0.51m.

The RTCs represent one of the main sources of energy and nutrients. Tubers represent almost 40% and 50% of the energy intake in Tonga, of which Taro is a vital component. It is an excellent source of both energy and fibre and, when eaten regularly, provides a good source of calcium and iron. Sweet potatoes (yellow and orange varieties) contain a high amount of Vitamin A. All other varieties of Sweet Potatoes contain good amounts of Vitamin C. Yams provide significant quantities of vitamin B1, vitamin C and dietary iron and niacin. Combined with fresh fruits and vegetables and right amount of meat products, should help deal with the NCDs and other diet related problems in the county.

Challenges for RTCs Su

The RTCs sub-sector has been seriously impacted by a few but major challenges. The most significant being that more than 90% of the 10,000 farmers who comprise the sector are small-scale producers. In addition, 95% of Tonga’s food security is met by these farmers. A fragile production base limits large scale production and undermines serious trade penetration in the major export markets. In addition, heterogeneous small players hardly produce a resilient crop especially when Tonga is faced with natural disasters, climate change effects and volatile trade prices. However, if the farmers can work together as a corporative or as a recognized collective agency, they can create a significant purchasing power for inputs and machinery, influence planned cultivation to control volume and prices, engage in mass marketing, freight negotiation, quality control and promote specialized training and research relevant to their needs.

The second major challenge is the unavailability of the right cultivars for large scale production and multiplication. Persistent lack of planting materials and weak farm infrastructure amplify this problem in Tonga. It is suggested that a commercial nursery could be developed to supply planting materials and seeds to promote the RTCs sub-sector. In addition, the scope of activities and outreach to farmers by the Ministry of Agriculture’s extension division needs to be improved. In addition, the Government could further promote the development of better agriculture infrastructure to facilitate easier access of planning materials, inputs and technology.

The third major issue relates to marketing. Since the main market for most of the farmers is local, the domestic market gets flooded with their produce, impinging on market price, farmer’s income and livelihoods. However, in order to benefit from the markets abroad which offer better returns; farmers have to deal with very high cost of export, freight and marketing, quality control etc. These result into low profits for the farmers. The need for cash has resorted farmers to diversify into other crops, for example fruits, vegetable and squash. Due to poor marketing and high trade cost, such exports have declined.

Forth, land ownership seems to have become a pressing issue for agriculture. In Tonga, although land can be leased formally or informally, it can be locally owned under freehold system. The national Constitution guarantees every adult male 8.25 acres of farming land, but with increasing population, this has been
impossible to maintain. In addition, non-Tongan international investors may only lease the land for periods up to 99 years. In reality, the lease term is normally much lesser and this can reduce international capital and technology input in the agriculture sector. The only leases which provide secure tenure are issued by the Ministry of Lands. Unfortunately, only 24% of land in Tonga is arable and this is slowly eroding with climate change effects.

A further challenge is that with limited growth of the sector, agro-processing does not exist in Tonga. There is huge potential for this industry given the scope of what can be done in order to add value to agriculture production. Some practical solutions can be suggested to overcome some of the limitations that undermine agro-processing. These include land reform, better investment climate, more research and development and etc.

Finally, there seems to be limited market information available to the farmers, traders and other important stakeholders. Better information flow will improve productivity and open up new trade based growth opportunities to farmers. This will amplify objectives of the Agriculture Strategy and promote the development of the sector. In returns farmers’ incomes and livelihoods will be much improved. There is a lot that can be done to improve farm productivity and trade of RTCs in Tonga. Ways to maximize the impact of such development on creating value chains are covered below.

Maximizing Value Chains

With limited development of this sector, value chains in RTCs are short and uneconomical. The major issues in maximizing value chains are, first: value creation. Agents, especially the farmers need to be better engage in commercial agriculture and value creation at different stages. Agro-processing will surely add to more meaningful value creation. Niche crop and organic agriculture is the other way to make the value chains more economical and meaningful. Currently, much of the produce is in raw form, and this attracts minimal incomes which has limited scope for amplifying value chains.

Second, there is a need for better production, monitoring and quality control systems. These will ensure a stable market and help deal with commodity price volatility. This is very important if export markets are to be sustained. The decline in exports of the major RTCs are somewhat linked to this limitations.

In addition, limited information is provided to farmers and other agents in the value chains. With a lack of credible market information, predicting effective internal/external demand and consequently, developing respective crop cycle is a problem. Finally, there is no agro-processing in Tonga which if developed could increase the value chains for RTCs.

One of the solutions to these important problems could be tangible public-private partnerships. The Government could work together with local and international partners to better develop this sector. Because Tonga is scattered small islands, everyone will benefit from the partnership.

In addition, Government’s administration and support services must be aligned and harmonized to gain economies of scale from such initiatives. Some of the initiatives could be to provide useful investment incentives, micro finance schemes, seed funds for capital investment, development of an input supply center, more packing facilities and material houses, better marketing and trade negotiations, quality assurance of products and grand connectivity with the farmers. The Ministry of Agriculture needs to set up a food technology processing unit in consultation with potential processors from abroad. This will boost agro-processing based value creation, employment and incomes for the stakeholders.

Finally, the Government must continue Research & Development initiatives in collaboration with major regional technical institutions. It must better integrate its policies with business strategies of the private sector. Government needs to promote investment in new technology, provide micro credit and or soft loans and develop skills and expertise of the farmers. The Ministry of Agriculture’s extension division should provide better and more on-the-field training to the farmers. For RTCs, a centralized seedlings production and capacity building may help. In addition serious bottleneck in facilitating RTCs exports must be considered with high degree of urgency.

Conclusions

In Tonga, agriculture is limited by small-scale subsistence farming. With the challenges identified for maximizing value chains, Tonga has a lot to learn and explore before it can fruitfully benefit from effective trade. There is a need for all stakeholders to collaborate so that high quality Tongan products are produced, processed and traded globally. It is hoped that some of the identified strategies will be useful for agriculture and more specifically for RTCs development in this country.
The Situation Analysis of Root and Tuber Crops Industry in Samoa

Tolo Levi Iosefa, Ricky Faatonu and Grant Percival

OVERVIEW

This paper on root and tuber crops production and development in Samoa focuses mainly on value chain analysis, and also discusses several key challenges or major issues and key strategies to strengthen and maximize value chains in the future. Also discussed are the case study of the Taro Leaf Blight in Samoa, and the benefits of sharing and distribution of plant genetic resources for taro improvement program through formal regional and international networking.

INTRODUCTION

The islands of Samoa in the Central South Pacific lie between latitude 13 degrees and 15 degrees south and longitude 168 degrees and 173 degrees west, close to the international dateline. The Independent State of Samoa consists of two main islands, Savaii and Upolu, with eight smaller islands.

The village economy of Samoa is dominated by village based agriculture, remittances from family members working overseas, tourism and external aid. The contribution of the agriculture sector (agriculture and fisheries) to the economy has shrunk significantly over the past 20 years from 17 percent in 1999 to about 10 percent in 2010, \( \text{(Agriculture Census 2009)} \). It contributed 90% to total exports. Apart from Food, Beverages & Tobacco and other Manufacturing Sectors, which also recorded decreased contribution to the Gross Domestic Product, all other sectors recorded increases in the same period.

The 2008-2015 Statement of Economic Strategies highlighted the production of an “Agriculture Sector Plan” that would provide a coherent framework for promoting the development of agriculture. The overall goal of the agricultural sector as indicated in the “Agricultural Sector Plan 2011-2015 is “to increase Agriculture’s relative contribution to GDP from its current level of 10 percent to 20 percent by 2015” \( \text{(Agriculture Census 2009)} \).

The challenge, as stated in the Agriculture Sector Plan 2011-2015, is therefore to revive village agriculture through initiatives to redevelop traditional agricultural crops as well as encouraging diversification. Government will provide support to agricultural development, namely research, extension, quarantine, regulation, marketing, information and infrastructure recognizing that the full development of crops shown to be technically viable requires private entrepreneurship.

Samoa’s farming systems are characterized by closely interdependent production activities that cut across the crops, livestock, fisheries and forestry sub-sectors. The production base is however narrow, being confined to a few root crops, vegetables and fruits that are grown haphazardly on a small scale, plus coconuts and cocoa grown as cash crops.

The food crops sector is dominated by production of root crops, which are produced in sufficient quantities to ensure adequacy of carbohydrates for the people. The requirements of carbohydrates are augmented by banana and breadfruit production. Coconut, which provides an important source of food and cash, is the predominant crop.

Traditionally the production of tree and food crops has dominated Samoa’s agriculture. Samoa has relied on coconuts, bananas, root crops, breadfruit and fish for much of its diet. However, the impact of natural disasters and the infestation by pests and diseases, such as the Taro Leaf Blight (TLB) in 1993, have contributed to the decline in crop production in the past two decades. The livestock sub-sector is mainly village based and is composed of cattle, pigs and poultry.
Sheep farming is a relatively new initiative with the first shipment of some 40 animals (Fantastic Sheep) from Fiji in 2004. These were raised by the Ministry of Agriculture and have been distributed to some farmers. Fishing is an important occupation in the village economy and provides a major source of protein in the diet. It is also an important source of cash income. It also provides a source of foreign exchange reserves through exports. During the last three decades, Samoa’s forest has been depleted to the point of near exhaustion through commercial and agricultural use.

Root and tuber crops like taro cassava, sweet potatoes and yams are the main source of carbohydrates and they are of high nutritional value. Aroids, mainly taro by far, were the main source of carbohydrates before the outbreak of TLB in 1993. The outbreak totally destroyed not only Samoa’s main food crop but also its main export earner which stood at the value of T$9.5 million from $16m in 1989 (largest export). This represented 60% of the value of Samoa’s exports in that year.

Introduced varieties from the Federated States of Micronesia, Philippines and Palau were multiplied and evaluated in trials from 1996 till 1999 and were proved to be more resistant to TLB. These varieties were then distributed to farmers’ for further on-farm evaluation and cultivation. In 1998, the five year AusAID TaroGen Project finally started, supporting taro breeding programs in PNG and Samoa with the objectives of providing farmers with improved varieties to overcome production constraints. Beginning in 2007, more than ten years after the breeding program began, new varieties began to be widely promoted to farmers for local sales and exports, although the distribution of these varieties is still constrained by the availability of planting material.

Emphasis is also now shifting to drought tolerance as a climate change strategy, nutritional and value adding potential and export market penetration. In Figure 1 below, we show the preparation procedure of exports of taro to the New Zealand market.

Figure 1: Preparing Taro Exports
Taro is one of the most important members of the aroid family in terms of production, utilization and commercialization in the Pacific Island Countries (PIC). In most countries of the Region, taro is one of the most consumable starchy foods by the majority of the population. In Samoa, taro is consumed in large quantities, and is the most important traditional starch in the everyday diet (Agriculture Census 2009).

Generally taro has good and complete nutritional quality in its edible parts (corm and leaves). Taro corms when cooked is a very good source of energy, high in carbohydrates, potassium, protein and dietary fibre (Agriculture Census 2009).

Recent studies showed that root tubers (including taro) with coloured flesh are very rich in beta-carotene, a component of Vitamin A, which is important for the body’s immune system (Englberger et al., 2003). Foods with high level of carotenoids have been shown to protect against chronic diseases including cardiovascular disease and diabetes. Taro leaf is rich in vitamins and minerals, and is a very popular and cheap vegetable consumed by Samoans.

Taro is a first choice crop of cultural and economic importance to the people of Samoa. Taro has a long history of social and cultural attachment in Samoan villages and rural societies. This sentimental attachment to taro is evident also in other cultures within the Pacific region. Taro is a high valued commodity for traditional social activities such as wedding, opening of a new church, school, community hall, funeral or any other traditional festivities. It is generally believed that the importance of taro economically and culturally to the Samoan people originates from the crop’s unique taste and its early association with the people’s culture. In Samoa, according to the 1989 Agricultural Census, 96% of agricultural households grew taro and it was reported that there were 16,000 hectares planted to taro, compared with only 3,600 hectares planted to ta’amu (Alocasia macrorrhiza), and 2,500 hectares under bananas prior TLB outbreak.

Taro was Samoa’s major export crop that was established slowly in late 1970’s, and then grew rapidly and became the country’s largest export earner from 1980’s till 1990’s, only to be interrupted by Cyclone Val in 1991. Taro production recovered rapidly and export volumes continued to climb until TLB disease, accidentally introduced into the country, completely destroyed the crop in the middle of 1993, Agriculture Census, (2009).

Because of TLB disease outbreak and susceptible nature of Samoan local cultivars, taro exports dropped dramatically and remained at a low level until recently, until new genotypes of taro from the regional breeding program based at USP Alafua Campus were released, evaluated and accepted by Samoan people. From 2002-09, the annual exports averaged around 153 tonnes, of which 82% had been shipped to American Samoa. In 2010 the first trial shipments of new genotypes were sent to New Zealand, McGregor (2011).

Taro is the main food staple of the country and the most consumable starch in everyday meal, followed by green bananas and breadfruit. Other root crops like ta’amu, talo palagi (Xanthosoma sagittifolium) and yams (mainly Dioscorea nummularia) are also consumed but are of lesser importance compared to taro. Cassava is not a popular root crop in Samoa but several people and villages planted cassava either as an animal feed or as a reserve crop in time of famine, especially in drought stricken areas.

Sweet potato (Ipomea batatas) is a short-term crop of minor importance to the Samoan people but have a potential as a substitute food crop in low fertility, saline and drought stricken locations of Samoa. Coloured sweet potato is very rich in vitamin A and is mostly preferred by non-Samoan communities, but the crop has received very little attention by the Samoan people. Sweet potato is high in nutritional value and, as a substitute food crop, it has been tested in extreme weather and soil conditions of the country.

Table -1 shows the production trend of the major root crops in Samoa. The data show a huge variability in production over the period 2005-2009 and this is attributed to weather and pest related issues.
The Situation Analysis of Root and Tuber Crops Industry in Samoa - Tolo Iosefa, Ricky Faatonu and Grant Percival

Issues and Challenges
A multitude of issues hinders value chains in major root crops, which impacts on local consumption and export. The major issues are:

- Lack of awareness and programs on post-harvest practices, leading to low quality produce and high reject rates.
- Poor access roads to farms making it difficult to reach the major markets.
- Climate change impacts leading to lower yields, less incomes and exports.
- Pest and disease impact on production with the potential to totally destroy the important RTCs.
- Lack of financial support to farmers impinging on activity, investment and growth.
- Poor networking between MAF, farmers, exporters and agro-processors in the country.

The Ministry of Agriculture, through its Research Division, must focus training on improving quality of taro exports and pest-free planting materials. The government should look at initiating food technology to explore processed agro-processed products from taro and other root crops. It should encourage farmers through frequent awareness programs and seek more opportunities for improving market access for export of taro and other crops.

Maximizing Value Chains
There are a few ways of maximizing value chains in taro. First, inputs need to be made freely available or at a discounted rate. Levies and taxes like VAGST must be lowered to zero. Stakeholders must be supplied with knowledge of product and markets. More value addition must be initiated through development of food technology infrastructure and research. There is a need for collaboration and maximize the use of resources, e.g. by involving research institutions such as the SPC and USP.

Conclusions
A few recommendations for policy are in order. First, there is a need to strengthen collaboration between government, private sector and research and funding institutions. More technical knowledge and farm support are required on developing improved varieties with increased yields and improved nutritional value. Government needs to align their legislations on food safety and inspection services.

Table 1: Production for Root Crops

<table>
<thead>
<tr>
<th>Crops</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taro</td>
<td>9343</td>
<td>10428</td>
<td>7329</td>
<td>10431</td>
<td>8839</td>
</tr>
<tr>
<td>Taamu</td>
<td>6399</td>
<td>7906</td>
<td>6623</td>
<td>5939</td>
<td>3217</td>
</tr>
<tr>
<td>Talo Palagi</td>
<td>579</td>
<td>869</td>
<td>589</td>
<td>413</td>
<td>314</td>
</tr>
<tr>
<td>Yam</td>
<td>176</td>
<td>264</td>
<td>554</td>
<td>302</td>
<td>381</td>
</tr>
</tbody>
</table>

Source: The Central Bank Bulletin
Journal of South Pacific Agriculture, Volume 18 (1), 2015

Issues in Value Chains of Taro and Yam in Vanuatu

Tari Molisale, Italio Borora, Esra Tumukon

OVERVIEW

Agriculture is the main economic activity that provides incomes and sustains livelihood of approximately 75% of population in Vanuatu. The total land area of the country is about 12,190 sq km, of which 1750 sq km of land is under agriculture cultivation. Almost all households on the outer islands and about 70% of the inland population are dependent on agricultural to meet their consumption and income needs. Even in the capital city (Port Vila), around 75% of urban households consume their own grown produce.

Yam is the most important root crop, but other RTCs such as Taro, Sweet Potatoes and Cassava are also grown in Vanuatu. However, like the other PICs, most of the RTCs are produced by subsistence farmers but only a selected range of crops has trade potential. Currently, production and trade of Yams face a lot of challenges but the newly established agriculture policy aims to increase productivity and commercial trade of Yams and taro to some extent.

The key issues in amplifying value chain in Yam production are networking, post-harvest handing and trade infrastructure. This paper intends to discuss the major issues with RTCs and identify the ways in dealing with some of the important limitations in the RTCs subs-sector. It is hoped that some of these strategies will be useful for the RTCs sub-sector of Vanuatu.

INTRODUCTION

Despite growing sectorial development, subsistence production continues to represents the major farming system. It is the strength of Vanuatu economy because, it creates the ability in local population to feed and support rural livelihoods. This is especially relevant during periods of disasters, loss of cash income and times of population displacement in rural-urban drift. Traditional crop production involves cultivating and managing small farms mainly through shift-cultivation where soil fertility is maintained by a bush-fallow system. However, subsistence production can sometimes fail, because of increasing population, diseases, pest & invasive species and extreme weather which can interrupt and disturb crop-cycles. As targeted in the Agriculture Policy, commercialization would mean a significant departure from traditional practices, hopefully with better technology and quality output.

Many tropical root crops such as Yams (Dioscorea alata), Taro (Colocasia esculenta), Cassava (Manihot esculenta) and Sweet Potatoes (Ipomoea batata) form important part of people’s diet in Vanuatu also. Whilst the importance of agriculture need not be over emphasized, livestock, copra and kava production represents a significant contribution to GDP and exports. In the RTCs sub-sector, Yam is a staple food crop grown on almost all the Islands of Vanuatu. It plays a significant role in domestic food security and used for social obligations as well.

It is common to find Yams being sold in the local markets. The National annual production of Yams is approximately 10,600 tonnes, (Vanuatu National Statistics Office 2007). There are approximately 390 local cultivars and 8 introduced cultivars from India. There are 8 species of Yams grown in Vanuatu and all cultivars are edible. Yams command higher prices than all other root crops because of their cultural significance. In addition, it can be stored relatively longer. The waste generated from Yam is used as mulch, for composting and animal feed. In 2012, approximately 39 tones of...
Yams were sold in the municipal market in Luganville alone (there are no data available for Port Vila). Soft Yams and wild Yams are grown mostly on Ambrym and Malekula. Maro (a head Yam) is grown mostly on Malo but recent distribution of planting materials now see them being grown on Ambrym, Pentecost, Vanua Lava, Tanna, Anetiyum, Futuna and Santo. There are special varieties that are restricted to certain areas such as Rull in North East Malekula, Maro on Malo and certain types of Wild Yams on Ambrym.

Similarly, Taro is also important in Vanuatu. The national annual production of Taro is approximately 17,200 tonnes and currently, there are approximately 360 local cultivars and 46 introduced Tansao cultivars from Asia. There are 3 species grown in Vanuatu, including Aelan Taro (Colocasia esculenta), Taro Fiji (Xanthosoma sagittifolium) and Navia (Alocasia macrorrhiza). For the latter, there are 8 edible varieties, 10 cultivars of \textit{Xanthosoma}, 360 cultivars of Colocasia. Aelan Taro is more popular and consumed widely by the local population, followed closely by Taro Fiji and Navia. Parts of the plant consumed include the corm, young leaves, and inflorescence (spud). The waste generated from Taro is used for mulch, composting and animals as well.

In 2012, approximately 49.5 tonnes of Aelan Taro and 19.3 tonnes of Taro Fiji were sold in the municipal market in Luganville. Navia is planted mostly in the Penama province and consumed locally. Consumption of Taro is higher in Penama, Sanma, Malampa and Tanna but is not exported out of Vanuatu.

Sweet potatoes are also cultivated, but mostly inter-cropped with Kava (a major export crop of Vanuatu). Sweet Potatoes are quite popular in Vanuatu for a variety of reasons. For example, they provide decent family incomes. O the production side, Sweet Potatoes crowd-out weeds as they do not compete with Kava for light. Additionally Sweet Potatoes are a good source of food for families and their yellow and purple varieties contain high amounts of important vitamins. Farmers use coconut frond mulch around Kava plants to conserve moisture, suppress weeds and prevent Sweet Potatoes from inter-twinning creating root competition.

However, apart from Yams, none of the other RTCs is exported. The survey above shows the prominence of RTCs in Vanuatu, especially for domestic consumption. Despite growing supply of imported food and cereals, root crops remain important for local population. It is thus important to diagnose further in this sub-sector.

Challenges in Maximizing Value Chains

The noted challenges below in maximizing value chains are common to all the major RTCs in Vanuatu. First, there are limited research and information on the findings of reliable value chain analysis being done for the RTCs in Vanuatu. This is partially due to expertise and data. Although expertise could be imported, micro level quality and consistent data are not adequately recorded and preserved.

Second, the RTCs in Vanuatu have not gone heavily commercial unlike how it has developed in Fiji, PNG and Samoa. Since there is very limited agro-processing at this stage, farmers do all the work along the value and supply chains (production, preparation, packaging, transport, and retail trade). Thus, the root crops are merely traded in raw and fresh forms.

Although this is useful, it undermines serious economic returns. Under-commercialization of the RTCs has had a toll on farm productivity and incomes, although not so much for food security. This could also be one of the major reasons why RTCs and agriculture productivity in general has remained low in Vanuatu.

In addition, there is a lack of proper roads and transport infrastructure that could support connectivity to major markets internally and abroad. This leads to high cost of transportation, loss of post-harvest quality and undermines trade potential of RTCs. It is estimated that approximately 10% of output per cycle is lost in this process. Whilst production is rural based, the major markets are in urban centers and therefore, effective transportation is essential. The loss of trade potential is exacerbated by unsustainable and intermittent crop supply as well.

Third, there is a lack of safe and high-yielding planting material, including the availability of major farm implements, which often needs to be hired. This undermines large scale production as good planting materials are essential for commercial production. Vanuatu needs more labs, nurseries, requisite technology and the technical know-how to promote RTC production in viable commercial scale. The availability of machinery and technology needs to be improved as well.

Further, there is limited information on market needs, tastes and requirements etc, that are being made available to the farmers and most
other stakeholders of the value chain. This is also because of poor farmer networks and connectivity. The majority of the rural farmers are unable to respond effectively to market demands. Improving connectivity through better farmer associations, ICT and information updates will usefully promote development of RTCs in Vanuatu. Connective could prove to be a key promoter of productivity and marketing.

Finally, there is a need for farmer training on raising productivity and on maximizing value chains. This could be hosted intensively on model farms provided by the key technical agencies in the region. The bottom line for such training should be that they are contextually applicable, promotes interest & innovation value creation in RTCs. This will potentially facilitate greater economic returns for farmers and other connected agents. Adequate training, education and important practical field information need to be updated and provided to these important players. The Ministry of Agriculture could play a major role in this facility. The agriculture extension needs to revamp their activities and establish better contacts with farmers and other stakeholder.

Strategies for Maximizing Value Chains

In order to deal with some of these challenges there are a few but important interventions which needs to be in order. First, the Ministry of Agriculture in collaboration with the FAO and Vanuatu Bureau of Statistics must improve the collection and storage of farm level data on RTCs because they are useful for important technical analysis. Second, the Government must provide incentives to local and international businesses to establish and develop agro-processing of RTCs in Vanuatu. This will promote production in larger scale and amplify farmer’s incomes and interest in RTC sub-sector. Agro-processors are a ready-market for the farmers. In addition, the RTCs value chain could be further extended through agro-processing to benefit a larger section of the society.

Third, rural collection, processing and storage centers that link major markets either by road or sea transport should be developed. Better modes of transportation linking major markets to these centers must be explored. These centers can also be a gateway to market information. In addition, the ICT coverage could be increased and a government subsidy on communication cost could promote connectivity within and outside Vanuatu.

Third, the Ministry of Agriculture, with the help of donor agencies and technical institutions could develop infrastructure for conservation, improved genetic resources and information. Special tissue culture labs, commercial nurseries and others need to be developed where farmers can get advice and planting materials from. This technical center should also conduct generic breeding, multiplication research and propagation techniques. They can also provide up-to-date market, technical and agronomic information to the farmers and other connected agents.

Finally, periodic training, educational infrastructure and information sessions must be developed to benefit producers, processors, farmers and traders. The Ministry of Agriculture’s extension services needs to be re-vamped with technology, transportation and funding to better out-reach the connected agents. It seems to be missing or has reduced impact on farm productivity. To boost trade of RTCs, the Ministries of Trade and Agriculture must collaborate. There is some scope for regional trade of RTCs as Vanuatu could partner with some neighboring countries to explore a common free-trade area, within or outside the partner countries. Fiji, Samoa and Tonga have better links with high-earned markets outside the region and possibly, through partnerships, such markets could be explored. However, one of the major factors for successful trade is large-scale quality production satisfying bio-security requirements and consumer tastes & preferences. Trade facilitation through improved connectivity and low trade costs are equally important.

Conclusions

RTCs remain important for food security, commercial activity and social needs of people in Vanuatu. Although RTCs are a major crop, they are mostly traded in local markets. Whilst Vanuatu has the highest Yam cultivar collection, Taro is another staple food crop. Although root crops are important, except for the Yams, they are non-viable export crop at this stage. To amplify its prominence, the efficiency, penetration and facilitation of trade in RTCs must be improved.

The value chain studies on RTCs need to be conducted to ascertain the real impact of Yams as a cash crop. Both data and expertise are needed for this to happen. There are currently good policies paving the way for further development of the RTCs, but the Ministry of Agriculture, other connected Ministries, donor &
development partners and regional technical & training institutions could collaborate to promote the development of RTCs in Vanuatu.
Root and Tuber Crops in Papua New Guinea

Therese Tariga

OVERVIEW

Food security has always been important. It has gained prominence over the past few decades due to the negative impact of climate change on agricultural productivity, soil quality and weather patterns. In addition, it is believed that growing world population could potentially lead a global food crisis. Data show that by 2020, world’s population is expected to reach 8 billion. On the flip-side, agricultural productivity may further deteriorate in absence of innovative interventions. Loss of farm productivity and climatic conditions are universal throughout the world. Food prices are expected to rise in the future creating negative implications on rural welfare and livelihoods of populations in low income countries and in fragile and dependent economies.

This paper discusses issues on maximizing value chains in RTCs in Papua New Guinea (PNG), the largest producer of tuber and root crops in the Pacific. It is also considered as the principle origin of a number of RTCs (Sweet Potatoes and Taro) grown in the region. The paper also discusses agro-processing in PNG and draws some useful lessons for development of RTCs.

INTRODUCTION

In the Pacific, every effort is being made to ensure that food security is not compromised. This is evident in the fact that the Technical Centre for Agriculture and Rural Cooperation sponsored a workshop in conjunction with the University of the South Pacific, the Institute for Research, Extension and Training in Agriculture and the International Society for Tropical Root Crops (Pacific Branch), to gather regional views on the current status, constraints and opportunities in maximizing value chains in root and tuber crops in Pacific Island Countries. These important institutions continue to support capacity development for RTCs and broader agriculture sector in member countries.

The challenge to ensure food security in the region is heightened because of threats posed by climate change, rising sea levels, poor soils and natural disasters. These will continue to compromise food security in the short-medium term because there is minimal value-adding and downstream processing of RTCs. In addition, domestic production capacity and established markets are needed to promote persistent growth of RTCs in the region. This is less forthcoming because RTCs are being replaced by imported cereal products derived from rice, wheat and barley. It may be noted that over-dependence on imports could potentially undermine food security and health standards. In PNG, malnutrition rates are high and per capita root crop consumption is low. PNG is also classified as a food deficient low income country, despite abundance of land and other resources.

The two main root crops cultivated in PNG are Sweet Potatoes and Potatoes, although others are also grown. Sweet Potatoes are by far the most important staple food in the country both for the highlanders and coastal populations. The time to maturity of RTCs vary between land types and altitudes but there are varieties that mature faster or later than the usual 6 months. Whilst much of the RTCs are consumed as a subsistence or own-use crop, it is an important income earner for many smallholder farmers in the highlands. Of the highland production of Sweet Potatoes, about 90% is traded informally in open markets, locally or in coastal urban markets in the country. None of the Sweet Potatoes is currently exported or converted into flour or other commercial products. Over the past years, small quantities are being processed at the National Agricultural Research Centre Laboratory and the flour is given to
Paradise Foods Limited to do trials for biscuit manufacturing.

Potatoes are an important cash crop in the highland provinces. Its commercial trade value has averaged 15,000 tonnes annually over the last few years producing a total value of Kina 10-15 million. This involves smallholders, many of whom also rely on Potatoes for food and income security. Barter trade in Potatoes is also widespread in the country which undermines the commercial then trade value.

An outbreak of Potato blight in early 2003 began destroying Potatoes throughout the highlands. The cause was believed to be a virulent and new strain of Phytophthora Infestan found in other Potato growing regions (for example, in some European economies) of the world. Other major problem is due to pests such as rats and pigs.

Potatoes have a relatively better export potential compared to Sweet Potatoes since it is more widely grown in PNG. Further, its potential for agro-processing is also brighter. The high sugar content in Sweet Potatoes is a major drawback in agro-processing as caramelisation could discourage diet conscious consumers. Taro and Yam are supplementary root crop in PNG. Taro is normally grown on lower altitudes and in the wet areas where soil fertility is high. However, its production is affected by pests and diseases. Yam is commonly grown in the dry regions and highlands but is a less prominent root crop for local the communities.

Major Challenges in PNG

Since PNG has very rough terrains and highlands, there is a lack of proper access roads for farmers to link to the major urban markets. The produce is transported in containers packed in nylon bags for those who can afford or in open-back trucks for those who can’t afford or others who produce in small quantities. Most of the produce is transported in 40 or 20 foot containers belonging to cooperative societies who consolidate output to supply the coastal cities and other urban centers.

However, there is a general lack of large commercial markets in PNG. In addition, there is a practice of the “push-inventory model” where farmers produce and market their produce disregarding the crucial demand side signals. This ultimately leads to loss in quality and economic value. In addition, the produce gets sold at a discounted price due to oversupply. Farmers are not trained to effectively manage post-harvest handling and costs. As such, there are a lot of second-stage losses along the supply chain which further undermines their income potential and livelihoods.

Further issues that undermine food security in PNG include lack of collaboration between various food programs, Government initiatives and private sector activities connected with the production and processing of RTCs. In addition, there is insufficient domestic food production which to some extent is undermined by inadequate support systems such as infrastructure, credit availability and government support. The lack of export drive program for root crops and inefficient research & extension services seem to undermine productivity. In addition, farmer training programs are not geared towards promoting farm productivity and innovation. High production cost of some introduced cereals, fruits and vegetables also undermine productivity and incomes of farmers.

With such a large population, PNG urgently needs to develop self-sufficiency and food security. Some of the negative consequences of these are high import dependence, welfare insecurity, poverty, poor health, low levels of nutrition and reduced life expectancy. Lack of food, due to either inability to produce or to purchase invariably contributes to lawlessness and social disorder as well.

Maximizing Value Chains

For the two most important RTCs, value chain analyses must be done to determine who the actors are along the supply chain, their inputs, challenges and the way forward. All human resources along the supply chain must be upskilled in the roles that they play. They must be trained in post-harvest handling, compliance, quality assurance, research & development and maintaining supply consistency and marketing. A proper web-based knowledge management system must be set-up in PNG for all stakeholders. This database may contain all work done by the stakeholders (research, field studies, nutritional information analysis, soil analysis and downstream processing etc) on these two major root crops and other food commodities. The Government must upgrade current roads to the highlands to ensure that the produce gets to the local markets. A lot of rural population is still inaccessible by road so all efforts must be made to ensure that they are better connected.

In order to overcome these challenges, a policy strategy for RTCs must be inserted in the existing national agriculture policy document.
This could guide the implementation of recommendations for reducing post-harvest losses, improving productivity and commercial value through better marketing, value adding and agro-processing. In addition, future generation of children must be educated about the value of traditional food and its impact on human health and welfare. They must be influenced at a young age on the economic importance of local food commodities as opposed to the common wisdom of local population that mining, timber, fisheries and other agricultural commodities are the only way forward.

Strategies for Promoting RTCs in PNG

A few important strategies may be useful in promoting RTC production and value addition in PNG. First, it is recommended that the Government needs to adopt an integrated rural development strategy contributing to food and nutrition security focusing on a limited number of high food insecurity areas each year. Community assessment and other stakeholder consultations may be used to decide on future streams of agricultural development activities. The Government, together with donor and international agencies needs to develop mechanisms for providing funds to support well-designed community projects in consonance with local needs. In addition, the Government can lead initiatives to strengthen rural credit and micro finance schemes. Further, in conjunction with Department of Health and/or Education and World Health Organization implement nutrition education and provide teaching-learning materials on protein energy malnutrition, anemia, non-communicable diseases and iodine deficiency in the country. It also needs to reconsider agricultural college curricula and local training programs that reflect farming systems approach to research and extension. There is a definite need for providing basic infrastructure such as roads, bridges, formal markets etc. It could also help develop mechanisms for improving communication links between the relevant groups involved, coordinate, disseminate market information, and identify new markets and products.

There is a need for developing potentials for large-scale production of traditional staples and RTCs with improved training and advisory services on post-harvest work, including storage, preparation, usage of waste and training in nutrition. In addition, the Government must develop a food processing program to educate women to produce for sale healthy snacks. It must encourage, promote and assist private sector participation in food production, processing, distribution and marketing. This would a long way to enhance agro-processing of RTCs in PNG.

In addition, the National Agricultural Research Institute (NARI) must conduct applied, adaptive and development-oriented research on food crops, alternative food and cash crops, livestock and resource management. NARI is responsible for providing authoritative technical, analytical and diagnostic services and up-to-date information to the entire agricultural sector - smallholders and semi-subsistence farmers in the rural areas, Government and processors. It can also link-up with USP (Samoa) for conducting specific agriculture and food technology research and collaborate with attracting development funding for capacity development for the region. As can be noted from above, there is a lot at stake for the policy, academic and research institutes for RTC development on PNG. Continued support from donors and UN agencies could make this a little less burdensome.

Conclusions

The root and tuber crops sector in PNG has a huge potential to increase its production. However, the government must have a policy in place to drive it, have the necessary infrastructure in place, including capacity building and locate markets for it through the private sector downstream processing. While all these work is going on, a growing population of school-aged children be influenced to make the right choices as adults thus making up a stronger internal market for root and tuber crops.

Future Directions

To develop the RTCs sub-sector, there is a need for clear policy direction, better agronomic practices, efficient market links and improved communications and networking. These can help improve productivity and value chains. Government needs to promote agro-processing, facilitate international certification and improve agriculture standards and quality. These will promote trade and competitiveness of globally.
Maximizing Value Chains in Root and Tuber Crops in the Pacific Island Countries: A consolidated Summary

Mohammed Umar, Satish Chandra and Rup Singh

OVERVIEW

This paper summarizes the major findings on maximizing value chains in RTCs for the Pacific Island Countries. It also presents a synthesis of the most important issues raised by the key stakeholders of RTCs in the region. A summary of key national strategies and recommendations for policy are also included to help develop a better future for the RTCs and agriculture in general for the Pacific Islands. The paper also presents a list of suggestions on developing future training programs for agencies working on RTCs. Consequently, the paper indicates a pragmatic agenda for capacity development for the region.

The paper is structured as follows. Following brief introduction below, key findings on value chain analysis, followed by a time-variant summary of important strategies and recommendations are presented. Conclusions and future direction on capacity development for the region are finally stated.

INTRODUCTION

The importance of agriculture on rural incomes, livelihoods and poverty in small and vulnerable economies such as the PICs has been heavily emphasized. This is largely because agriculture provides incomes, employment and supports livelihoods to about 60% of the people this region. In some countries (PNG, Solomon Islands, Samoa and Tonga), almost 80% of populations live in rural, remote places being solely dependent on agriculture. However, increasingly, the prominence of agriculture is declining in favor of market oriented services sector activities. This is due to income security, growth in technology, trade openness, population shifts, changes in the structure of the economies and climate change. These have had significant impact on agricultural productivity and rural livelihoods. Regional Governments, researchers and donor agencies have to respond to this important dynamism to rural development, welfare and livelihoods.

Declining farm productivity has changed the dynamics of agriculture and agro-base trade globally. Both the supply and prices of traditional crops such as wheat, milk, eggs, cereals and grain, including livestock have increased rapidly since the 1980s. Root and Tuber Crops (RTCs) have remained relatively less prominent but remains important fall-back to food crisis. This is because it can accommodate to declining soil fertility, volatile weather papers, large spells of dry weather and salinity. The RTCs are also the most important sources of dietary energy, in the form of carbohydrates, dietary fiber, certain vitamins and minerals. Data show that over 90% of the RTCs produced domestically are consumed as staple foods in the PICs, universally across all the countries. Taro, cassava, yams and sweet potatoes are the most prominent varieties, but more climate resilient and adoptable varieties of these crops are being cultivated in the region. RTCs also contribute to PIC’s exports in raw form but more importantly in terms of processed products mainly in Fiji, PNG and Samoa.

The Key Challenges

The key challenges identified before vary from country to country but can be prioritised as follows:

- There is an urgent need for capacity development related to increasing productivity, trade, post-harvest losses, access to technical and market information including certification.
- Throughout the region, there is a need for developing supply...
consistency, quality assurance, compliance with food safety standards and bio-security.

- There is a need to develop supporting infrastructure such as access roads, wharfage, freight, collection centres with improved logistical support.

- Establishment of new international markets, trade networks and other soft infrastructure are needed to improve market access.

- There is a need for on-farm research and technical training, possibly in conjunction with the Research and Extension Divisions of the Ministries of Agriculture, regional and local Universities and other agriculture training institutes.

- The region needs expertise for developing value chain analyses, scientific studies and for providing technical information to stakeholders.

- In addition, there is a need for more scientific experiments on agro-processing, funding support for upgrading food technology programs and laboratories at the regional universities.

Key Findings on Value Chains

The following summarizes the key findings on value chain analysis on RTCs for the Pacific. Attention to these could improve economic value of RTCs for the stakeholders.

- Stakeholders need to reduce production and trade costs in order to maximize value chains in the RTCs sub-sector.

- More research on qualitative value chains is required given that individual country’s capacity is limited by the lack of technical expertise and data constraints.

- There is a need for fair trade in agriculture, a lack of which creates unfavorable economic returns in the industry. Safer produce which is non-GMO, chemical and disease free must be compensated with a fair value, compared with the returns of commercial producers who use potentially unsafe methods.

- It is important to train research and extension officers on conducting scientific analyses and report writing.

Key Strategies and Recommendations for the Region

The synchronised country strategies prioritised along a list of short-to-medium and long-term are stated in this sub-section. These are important areas of development for RTCs for the region.

- Develop and upgrade farming infrastructure identified identified under capacity development needs. This will ease costs of agriculture and agri-business from the region. It will also lead to greater volumes of RTCs marketed as well as generate additional volumes for agro-processing and export penetration.

- Regional Governments must provide incentives to farmers for engaging in agricultural activities, for example, soft loans, agro-inputs, commercial nurseries, cost-reduced planting materials and better extension services. The Extension Division of Ministry of Agriculture could play a lead role in this area.

- There is a need to develop networks to link farmers with internal/external markets globally. An up-to-date web-based database and information management system maintained by each of the MOA’s research or marketing divisions could help. Such a database could be developed and maintained by Government’s data agency and the Ministry of Agriculture.

- Regional strategy for short courses and training sessions on smart agriculture, technical knowledge, best practices, farm management, record keeping, financial planning and budgeting must be developed. Institutions such as the agriculture teaching Universities and Colleges could provide suitable training courses.

- Regional Government must institute directed policies on the development of RTCs based on the national agriculture policy
framework. Some countries such as Fiji and PNG are already embarking on developing policies on RTCs but a lot remains to be done. There is an urgent need to set-up RTCs policy in Samoa, Tonga, Vanuatu and Cook Islands.

- All countries must promote organic farming, soil and environment conservation through better farming practices, advocacy and agricultural shows. This information should be promoted by the Ministry of Agriculture and the outreach should involve targeted secondary schools in rural areas.

- The regional agriculture research agenda must include food nutrition and sufficiency studies, value chain analyses, envelope analyses, gross margin analyses and studies on alternative livelihood systems. The Universities in the region could have an important role in conducting such studies and undertaking the various types of analyses.

- Regional Governments must determine farm-gate price through better engagement, information and voice of farmers. Although direct price setting is not the role of Governments in the free market economies, timely information on prices can assist information flows that would help RTCs producers and consumers.

- Develop stronger public-institutional-private sector partnerships that can boost synergies in pooling research findings, funding support and technical knowledge.

**Long Term Strategy for the Region**

- Diversify agriculture to include new markets and products. PNG, Fiji and Samoa are already well established in processing RTCs but greater product volumes could be generated if suitable markets are developed.

- Develop organic farming and explore markets that provide better value for organic products. There is a worldwide trend for “clean and safe foods” i.e., foods that have not used pesticides and other chemicals.

- Diversify into new local and international markets. Searching for new markets in Asia is a strong possibility. Also supplying products during their off-season periods could be explored.

- Review the academic curriculum for agriculture at the high school level to promote RTCs. In addition, there is a need to upgrade the food technology infrastructure, curriculum and equipment at the USP in Samoa.

- Undertake agro-processing trials and attain certification which will be useful for potential agro-processing investors.

- Support research activities for developing improved varieties suitable for various soil and climatic conditions. Develop and sustain large-scale planting material and multiplication systems for the RTCs in Samoa, Vanuatu and PNG respectively. In addition, adopt well-tested farming modalities.

- Develop export promotion in agriculture which will require producing and maintaining quality products and developing quality assurance processes.

- Promote traditional food preservation knowledge. In-depth case studies and interviews of selected farmers would be a good starting point. In addition, there is a need for research into developing new methods and technologies for food preservation.

- Countries should pool resources, expertise and funding to deal with generic problems facing the region. Some specific activities may be best undertaken through well-structured longer-term donor and technical support in conjunction with local research institutes and universities.

- In addition, the USP-IRETA would be very well placed to have Masters and PhD students undertake specific research studies in solving some of the generic problems
facing RTCs.

**Long Term Strategy for the Region**

The PICs need to better agriculture policy which can suit dynamic changes to economic and natural environment, promote smart agriculture, provide technical knowledge and enhance R&D. These will help grow incomes, mitigate climate impact and sustain livelihoods. Secondly, they need to develop better networks to promote productivity, agro-processing and trade capacity.