

Tropical root crops: the impact of climate change on future production and utilisation in the South Pacific Island countries

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Abstract

Tropical root crops – cassava, sweet potatoes, aroids, yams and potatoes – are very important staple foods in the world. Around one billion people regularly consume these crops. The world per capita annual consumption of root crops is about 107kg. In the South Pacific Island Countries the per capita annual consumption of tropical root crops is around 200kg. Most of the production and consumption of tropical root crops in the South Pacific Island Countries occurs in subsistence and semi-subsistence settings. Climate change is expected to have a major impact on the world production and consumption of tropical root crops. No where else will the impact of climate change be more significant than in the low-lying island nations of the South Pacific. World renowned climate scientists are predicting the sea level to rise by 1-1.5m by the turn of this century. In countries such as Kiribati and Tuvalu, where most of the people live at elevations of less than 2m above sea level, the rising sea level will be catastrophic for the tropical root crop producers and consumers. In other South Pacific Island Countries which have a significant number of low-lying islands or areas, such as in Fiji, Tonga, Cook Islands, Vanuatu, Niue, and Wallis and Futuna Islands, the rising sea level will also be equally devastating for a large number of tropical root crop producers and consumers.

Keywords: climate change, sea level rise, food security, tropical root crops, world production, South Pacific Island Countries

Climate change and the world root and tuber crop production

For the first time in human history the world is facing significant global warming that is likely to lead to catastrophic effects on world food security. Renowned world climate scientists are predicting that the sea level will rise by 1.1.5m by the turn of this century (Chandra, 2009a,b). This will have devastating consequences for some tropical root crops (TRC) producers and consumers.

The TRC are important staple foods in the world (Table 1). The annual world production of cassava is 228mt, sweet potatoes 126mt, taro 52mt, yams 12mt, and potatoes 322mt. The world root crop production has steadily increased from 688mt in 2001 to 740mt in 2007. TRC are especially important to poor and vulnerable people living in the tropics and sub-tropics who regularly produce and consume TRC in subsistence and semi-subsistence settings. For them any negative impact of global warming will mean even more poverty, hunger and malnutrition.

However climate change's effect on the future of TRC in the world is not only due to sea level rise. Others factors are at play which make TRC even more important than they are today in ensuring world food security and perhaps improving food security in some settings. First, the world cereal production has stabilised at around 2bt and the world's cereal stock has declined from around 116 days supply to around 57 days supply i.e. world cereal food security is declining. Second, world population growth is now outpacing world cereal production growth meaning that cereal consumption per capita is declining. Third, rising incomes in the West are diverting cereal production into animal feed to convert to beef, poultry and pork. Fourth, declining and more variable rainfall in the main cereal production zones is reducing yield and quality. Fifth, diverting food crops such as maize, cassava, oil palm and sugar cane to produce bio-fuels for motor vehicles is further reducing world food security. Sixth, water is becoming a declining and more expensive resource thereby putting additional pressure on non-TRC food production.

Table 1. World Root and Tuber Crop Production (1000t) in 2007

Region	Cassava	Sweet-potatoes	Yams	Taro	Potatoes
Africa	117,888	13,478	50,137	9,506	16,323
North America, Central America, Caribbean	1,438	1,466	533	19	24,958
South America	36,808	1,288	692	9	13,792
Asia	71,808	109,339	237	2,039	135,608
Oceania	196	649	347	376	1,659
Europe	-	79	2	-	129,396
World	228,138	126,299	51,948	11,949	321,736

Source: FAO Statistics Division 2009.

These factors all point to the increasing importance of TRC for the future world food security. The underpinning factor is that TRC have high efficiency ratios in their production and in their conversion to consumable products surpassed by no other staple food crops in the world.

Tropical root crop production and consumption in the south pacific

TRC are very important staple foods in the South Pacific (Table 2). Papua New Guinea is the largest producer of cassava, sweet potatoes, yams and taro totalling over 1.5mt annually. Other large producers of TRC in the South Pacific are: Fiji, Federated States of Micronesia and Tonga for cassava; Solomon Islands, New Zealand and Tonga for sweet potatoes; Solomon Islands, New Caledonia and Fiji for yams; Solomon Islands, Fiji and Samoa for taro; and Australia, New Zealand and New Caledonia for potatoes. A number of other TRC are important food crops in the South Pacific Island Countries such as *Alocasia* taro in Samoa and Tonga, *Xanthosoma* taro in Fiji and Vanuatu, and a large number of indigenous varieties of yams in Papua New Guinea, Solomon Islands, Vanuatu and Fiji.

Other notable features of Table 2 are: (a) the large mixture of cassava, sweet potatoes, yams, taro, and other root crops consumed within a country which gives some indication of their individual seasonal importance and together their overall importance in providing food security throughout the year, and (b) the relative importance of some TRC over others between the different countries indicating the unique ecological settings within the islands where TRC are grown. In some coral atolls, such as in Kiribati and Tuvalu, the ability to grow cassava, sweet potatoes, potatoes, yams and taro is very difficult because of their meagre soil and little fresh water.

Food security in remote island settings is synonymous with the ability of the people to produce TRC throughout the year. Relative to the rest of the world TRC in the South Pacific Island Countries have much greater food security value because of the absence of other major staple food crops. For this reason the South Pacific Island cultures are intimately entwined with TRC production and consumption. Sweet potatoes, yams and taro have a long and historical significance for the indigenous communities of the South Pacific. Cassava is a relatively recent introduction in the South Pacific, first introduced into Fiji around 1855. Only sweet varieties of cassava were ever introduced.

The population, production and consumption of TRC in the South Pacific are shown in Table 3. A notable feature of Table 3 is the very high reliance placed on TRC as the main source of staple food – 14 countries have an annual per capita consumption rate of over 100kg; 6 countries (Cook Islands, Niue, Papua New Guinea, Solomon Islands, Tonga, and Wallis and Futuna Islands) have an annual per capita consumption rate of over 200kg.

Table 2. South Pacific Root and Tuber Crop Production (t) in 2007

Country	Cassava	Sweet-potatoes	Yams	Taro	Potatoes	Unspec.	Total
American Samoa	100	-	820	9,000	-	-	9,920
Australia	-	4,500	-	-	1,150,000	-	1,154,500
Cook Islands	1,500	700	-	-	-	2,500	4,700
Fiji	34,500	6,000	5,200	38,000	80	3,700	87,480
Federated States of Micronesia	12,000	3,200	-	-	-	-	15,200
French Polynesia	4,300	-	-	-	900	5,250	10,450
Guam	-	130	-	-	-	2,500	2,630
Kiribati	-	-	-	2,200	-	8,200	10,400
New Caledonia	3,200	3,200	12,500	400	2,400	-	21,700
New Zealand	-	18,500	-	-	505,000	-	523,500
Niue	50	260	130	3,300	-	-	3,740
Papua New Guinea	125,000	520,000	290,000	260,000	900	306,000	1,501,900
Samoa	370	-	2,700	17,600	-	3,000	23,670
Solomon Islands	2,500	86,000	30,000	40,000	-	-	158,500
Tokelau	-	-	-	-	-	300	300
Tonga	9,700	6,800	4,700	3,800	-	2,150	27,150
Tuvalu	-	-	-	-	-	150	150
Vanuatu	-	-	-	-	-	43,000	43,000
Wallis and Futuna Islands	2,550	-	560	1,700	-	1,100	5,910

Source: FAO Statistics Division 2009.

Table 3. Population, Production and Consumption of Tropical Root and Tuber Crops in the South Pacific in 2007

Country	Population	Production (t)	Consumption (kg/capita)
American Samoa	63,450	9,920	156
Australia	21,153,000	1,154,500	55
Cook Islands	21,100	4,700	223
Fiji	840,250	87,480	104
Federated States of Micronesia	106,150	15,200	143
French Polynesia	251,000	10,450	42
Guam	174,500	2,630	15
Kiribati	92,000	10,400	113
New Caledonia	230,000	21,700	94
New Zealand	4,150,000	523,500	126
Niue	1,420	3,740	2634(a)
Papua New Guinea	5,910,000	1,501,900	254
Samoa	161,100	23,670	147
Solomon Islands	531,500	158,500	298
Tokelau	1,580	300	190
Tonga	105,000	27,150	259
Tuvalu	10,000	150	15
Vanuatu	220,500	43,000	195
Wallis and Futuna Islands	15,000	5,910	394

Source: FAO Statistics Division 2009 and other sources.

(a) An anomaly due to a very large share of the production being exported.

Effect of sea level rise on tropical root crop producers and consumers in the south pacific island countries

A significant proportion of TRC production in the South Pacific Island Countries is produced on land barely 3-5m above sea level consisting of coral atolls, river deltas and coastal strips of land where subsistence and semi-subsistence agriculture is practised. Living close to the sea has been important for most South Pacific islanders for a very long time; as it enables them to do subsistence and semi-subsistence fishing which is a key source of animal protein. It also enables other important food crops to be grown with TRC such as coconuts, breadfruit, pandanus and bananas to supplement the diet.

Because of the South Pacific islanders' preference to live by the sea, a large number of countries in the South Pacific are vulnerable to even a small rise in sea level. For example around 400,000 people in the South Pacific live on elevations less than 2m above sea level. Most of these people live on low-lying coral atolls. Everyone in Kiribati (92,000 people) and Tuvalu (11,000 people) live on coral atolls, with maximum elevations of 4m and 3m above sea level respectively.

Other countries in the South Pacific that have a significant number of inhabited coral atolls and low-lying areas threatened by rising sea level are in Fiji, Tonga, Cook Islands, Vanuatu, Niue, Federated States of Micronesia, American Samoa, Tokelau, and Wallis and Futuna Islands. All these countries are important producers and consumers of TRC.

The future of the South Pacific TRC producers and consumers living on low-lying coral atolls and other low-lying areas is bleak. Scientists predict that within 50 years most of these low-lying areas will become inhospitable, with seas inundating the main production zones, thereby unable to support a sustainable population as at present. The only alternative left for the islanders would be to migrate to other nations.

The special case of Kiribati and Tuvalu

The people of Kiribati and Tuvalu are Micronesians. They have been living in these low-lying coral atolls for around 3,000 years, most likely having originated from the West from the Asian mainland. The main TRC produced and consumed in Kiribati and Tuvalu is the giant swamp taro (*Cyrtosperma chamissonis*); no other TRC can be grown as successfully. Giant swamp taro has been grown in Kiribati and Tuvalu since 1000-1200AD. There is now a rich folklore centred around its production and consumption.

Giant swamp taro is grown in dugout coral pits which enable fresh water for plant growth to be drawn in from adjacent water lens; there are no running streams in Kiribati or Tuvalu. The soil is very shallow, alkaline coralline material. Plant organic matter in the form of dry coconut, breadfruit and pandanus leaves is used as mulch around the base of the giant swamp taro plant. Used tinned fish and meat cans are sometimes put around the plants to increase iron content of the soil which has severe iron deficiency. Giant swamp taro usually takes 18 months to 2 years to grow to harvestable size. Annual per capita consumption of giant swamp taro in Kiribati and Tuvalu is around 81kg. Other TRC consumption is around 21kg per capita.

Predictions are that within 30-50 years the people of Kiribati and Tuvalu will have to move to other nations as their land will become inhospitable through rising sea level.

Other projected impacts of climate change on tropical root crop producers and consumers in the South Pacific Island countries

Scientists predict that global warming will not only lead to rising sea level but will also cause: (a) greater variability in rainfall patterns, (b) more intense tropical cyclones, and (c) changes in the onset of El Nino Southern Oscillation.

For some TRC producers and consumers in the South Pacific Island Countries the projected effects of climate change are likely to be challenging because the countries: (a) are surrounded by large expanses of ocean, (b) have little natural resources, (c) are prone to natural disasters such as hurricanes and tsunamis, (d) are relatively isolated making attaining food security difficult, (e) are small, fragile economies highly dependent on aid, (f) have rapidly increasing populations mainly due to high fertility, declining infant mortality and increasing life

expectancy, and (g) have rapid urbanisation thereby reducing subsistence and semi-subsistence life-style food security.

In this context it is sad state of affairs that the tiny South Pacific Island Countries, which collectively account for a mere 0.0012 per cent of the global greenhouse gas emissions, are the most vulnerable in the world through global warming (Australian Bureau of Meteorology, 2007).

Conclusions

TRCs are very important staple foods in the world. In the South Pacific Island Countries the per capita annual consumption of TRC is around 200kg. No where else in the world will the impact of climate change be more significant than in the low-lying island nations of the South Pacific. World renowned climate scientists are predicting the sea level to rise by 1-1.5m by the turn of this century. In countries such as Kiribati and Tuvalu, where most of the people live at elevations of less than 2m above sea level, the rising sea level will be catastrophic for TRC producers and consumers. In other South Pacific Island Countries which have a significant number of low-lying islands or areas, such as in Fiji, Tonga, Cook Islands, Vanuatu, Niue, Federated States of Micronesia, American Samoa, Tokelau, and Wallis and Futuna Islands, the rising sea level will also be equally devastating for a large number of TRC producers and consumers.

References

- Australian Bureau of Meteorology. 2007. South Pacific Sea Level and Climate Change Monitoring Project, Canberra, Australia, 172p.
- Chandra, S. (2009a). Evaluation of the Kiribati Country Strategy – 2002 to Present. Report to NZAID, Wellington, New Zealand, 77p.
- Chandra, S. (2009b). Evaluation of the Tuvalu Country Strategy – 2002 to 2007. Report to NZAID, Wellington, New Zealand, 68p.
- FAO. (2009). Statistics Division, Rome, Italy.