Specialty Crops for Pacific Island Agroforestry (http://agroforestry.net/scps)

Farm and Forestry Production and Marketing Profile for

Giant taro

(*Alocasia macrorrhiza*)

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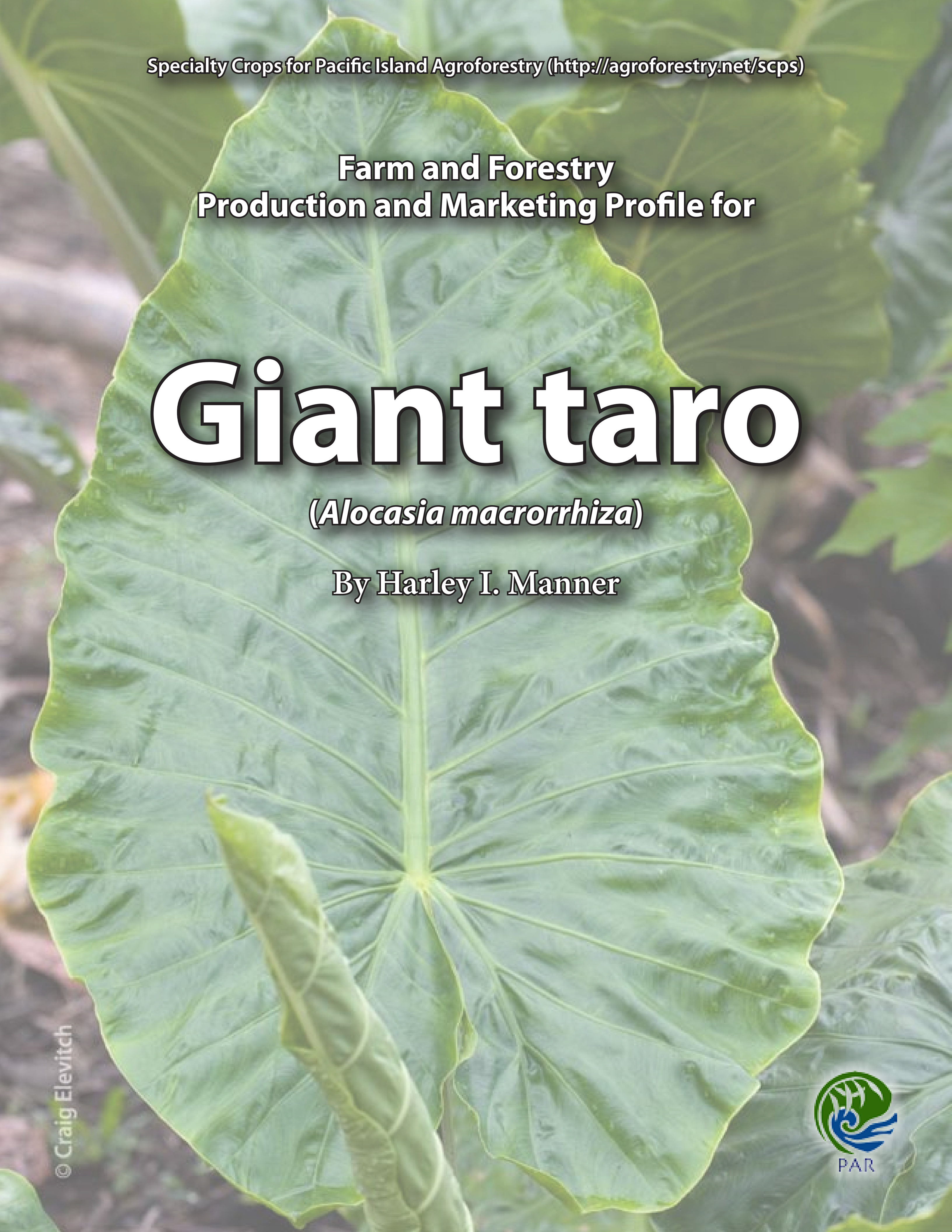

PAR

USES AND PRODUCTS

Giant taro is mainly grown for its starchy upright stem. In the Pacific islands, the stems are roasted, baked, or boiled and eaten as a starch.

In India and Bangladesh, the stem tuber is peeled, cut into pieces and eaten as a vegetable after cooking, usually in curries or stews. Older stems may require prolonged cooking with several changes of water to remove acridity (Kay 1987).

Giant taro is sometimes used as a source of a very white, easily digested starch or flour. The underground corms and cormels are used for food after thorough cooking, particularly in times of scarcity. The leaves may be eaten (e.g., fried with onions, garlic, chili, etc.). Giant taro is widely grown in certain areas as an ornamental foliage plant (Kay 1987). Foliaki et al. (1990) note that as the percentage of starch in giant taro stems ranges between 16% to 21%, the *Tonga* cultivar that produces over 78,600 kg/ha/year could produce 12,300–16,800 kg/ha/year of starch.

Secondary and waste products

The corms and leaf juices (latex) are reportedly used for medicinal purposes in India and the Pacific islands. The plant was formerly cultivated in Brazil, where it was utilized as a pig feed. It has also been investigated as a possible raw material for the production of ethanol (Kay 1987). In Tonga, giant taro was second to yam as a presentation crop to the nobility.

Foliaki et al. (1990) suggest that based on the high yields of giant taro cultivars grown on the Hāmākua coast of Hawai'i Island, the stems and leaves of giant taro are a potential silage for cattle, swine, and poultry. While the stems have little protein, leaves contain 4.3% protein. The development of methods for processing leaves and stems for silage is needed.

Scale of commercial production worldwide

Most commercial production of this species is confined to the Pacific and SE Asia. For the Pacific, the amount of commercial production is small in contrast to the commercial production of *Colocasia esculenta* and *Xanthosoma* spp., with most production occurring in Samoa, American Samoa, and Tonga.

BOTANICAL DESCRIPTION

Preferred scientific name

Alocasia macrorrhiza (L.) G. Don

Family

Araceae (aroid family)

Top: Young Meldin, a Fais Islander pictured with 2-year-old giant taro stem. The stem is 48 cm in length. July 2009. Bottom: The peeled giant taro stem is ready for cooking. The peelings and other waste scraps will be fed to the family pig. July 2009.

Giant taro stems for sale at farmers' market in Apia, Samoa. December 2006.

Non-preferred scientific names

Alocasia indica (Roxb.) Spach
Alocasia macrorrhizos (L.) G. Don
Arum macrorrhizon L.
Arum costatum of Christian, pro parte, non Wall.
Arum cordifolium Gaud., nom. nud.
Arum cordifolium Wilkes et al. pro parte?
Arum indicum Lour.
Colocasia gigantea Hook. f.
Colocasia macrorrhiza (L.) Schott
Colocasia indica Kunth.

Common names

Chuuk: *kalap, kachik, kä, kká, kka, pwerik*
Cook Islands: *kape*
English: giant taro, Egyptian lily, elephant's ear, giant alocasia
Fais: *fila*
Fiji: *via, via nganga, viandindi, viandranu, viamila, viasori, viandini*
French: *alocasie*
Hawai'i: *'ape*
Ifaluk: *file*
Kapingamarangi: *ngaungau*
Kiribati: *te kabe*
Kosrae: *onak owa, onak wed, sra onak* (inedible)
Lamotrek: *file*
Malaya (Keladi Sebaring): *birah*
Marshall Islands: *ot, majol wot, wat, wot, wõt*
Murilo: *oht*
Namoluk, Nomwin: *ka*
Namonweito: *oot*
New Caledonia: *aware, ica, ka'ait, kape, kaxete, koe, kowe, poaere, moerere, peka, pia, pidu, twowe, wave*
Niue: *kape*
Palau: *bisech, bisech ra Belau*
Papua New Guinea: *paragum*
Philippines: *biga, aba, aba-aba, badiang, bagiang*
Pohnpei: *cha, sepwikin, oht*
Samoa: *ta'amu*
Satawal: *file*
Solomon Islands (Kwara'ae): *fila, fila kwasi, vila, fila fanua*
Spanish: *camacho, malanga*
Tahiti: *ape, 'ape*
Tokelau: *ta'amu*
Tonga: *kape*
Tuvalu: *ta'amu*
Ulithi: *fole*
Tonga: *kape*
Vanuatu: *lese-en, pia*
Wallis & Futuna: *kape*
Woleai: *fille*
Yap: *monuw, maching, lai, la'iy*

Brief botanical description

Large herbaceous plant, up to 5 m in height, with broad, fleshy sagittate (arrow-shaped), undulate (wavy) edged leaves 1 m in length. Leaf midrib is broad and conspicuous with 4–7 primary lateral veins per side. Leaves are slightly peltate (shield-shaped) when young, but less so when mature. Leaf apex of live plants point upwards while basal lobes point downwards. Basal lobes are cordate (heart-shaped), with a blunt or rounded apex. An easy way to distinguish *Alocasia* from *Xanthosoma* is to compare the angle of the leaf to the petiole (stem). In *Alocasia*, the petiole and leaf blade are aligned in the same plane. For *Xanthosoma*, mature leaves are angled about 30° off the plane of the petiole.

Lactiferous cells release a milky sap. Plant contains fine, needle shaped calcium oxalate crystals. The tuber is an erect woody stem 1 m in length, 20 cm in diameter, and weighing up to 20 kg. Cataphylls (reduced leaves) are persistent, 25–95 cm in length.

Two or more inflorescences are subtended (enclosed or surrounded) by bracts. Peduncles are 20–45 cm long. The spathe is a whitish to yellowish green, oblong tube, 13–35 cm long and 4–6 cm wide. The spadix is 11–32 cm in length with the pistil 3–4 cm long and about 1.5 cm thick. Berries are ovoid, scarlet, 8–10 mm long.

Left: Giant taro plantings in an old agroforest near Kolonia, Pohnpei. Pohnpeians have developed very species diverse and productive agroforests that provide food, timber, construction materials, dyes, medicines, beverages, and many other culturally valued products. August 2003. Right: Inflorescence of a 2-year-old giant taro plant on Falalop Islet, Ulithi Atoll. The red-brown and white spadix is approximately 15 cm in length. Older and withered brown to black spathes and spadixes are shown on the lower right side of the plant. June 2008.

DISTRIBUTION

Giant taro is native to tropical Southeast Asia, India, and Sri Lanka. The plant is commonly found in humid moist, low, and medium elevation valleys where it is naturalized along stream banks in mainly secondary and disturbed forests and old clearings. Today it is found throughout the tropics. In all probability it is an aboriginal introduction into Pacific islands, where it is found on all high islands and many atolls. The list of common names above indicates the extent of its Pacific distribution.

ENVIRONMENTAL PREFERENCES AND TOLERANCES

Climate

The species is mainly found in humid tropical and subtropical climates and those which have a short dry season. Temperatures below 10°C are detrimental to its growth (Kay 1987). Kay also writes that this species requires more than 1,700 mm of rainfall evenly distributed throughout the year and that it cannot survive a long period of drought. While the species is found naturally along stream banks, it cannot stand waterlogging (Kay 1987).

It is probably the best adapted of the edible aroids to drought as evidenced by its cultivation in limestone rocky soils of low water holding capacity. Pole (1993) has suggested however, that this distinction belongs to *Xanthosoma* taro (even though giant taro has a much thicker and presumably more drought-resistant leaf). Assuming that the temperature preferences for giant taro are similar to that of *Colocasia* taro, the preferred temperature range for maximum photosynthesis is 25–35°C, with 30°C being the optimum. Lower temperatures increase the number of days to maturity and reduce the size of the corm and yield (Prasad and Singh 1991).

Table 1. Environmental tolerances.

Elevation range	**lower:** 0 m (sea level) **upper:** 600 m (Fiji)
Mean annual rainfall	**lower:** 1,500 mm **upper:** 5,000 mm
Rainfall pattern	Can grow in climates with summer, winter, bimodal, or uniform rainfall. Tolerates up to 4 months of drought.
Mean annual temperature	**lower:** 23°C **upper:** 31°C
Minimum temperature of coldest month	10°C

Soils

This species tolerates a wide range of soils, ranging from freely drained sandy soils on atolls to deep, well drained clayey soils of valley bottom lands. It is rarely cultivated in swamps and marshes, as it does not tolerate waterlogged soils.

On Fais Island, *Alocasia* is also planted in small earth-filled crevices and holes in the exposed limestone substrate.

GROWTH AND DEVELOPMENT

The crop life is usually 12–18 months, but harvesting can be delayed for up to 4 years (Kay 1987). In Tonga, giant taro is harvested a year after planting (Holo and Taumoefolau 1982). In Wallis, it is harvested from 12 months to more than 2 years after planting (Nozières 1982).

For Samoa, Cable and Ashgar (1984: 85–86) wrote that generally it takes "two to three years to reach edible quality" and that "Virtually no data are available on growth and comparative quality of taʻamu varieties.” With regard to one cultivar trial, they noted that “After one year the greater circumference of taʻamu *Faitama* may be explained by its greater number of initially longer leaves. Later the larger size of *Laufola* leaves partially offset its lesser number to give moderate circumference. The intermediate circumference of taʻamu *Toga* may result from the intermediate number and length of leaves. The small circumference taʻamu *Niu Kini* is perhaps related to its short leaf length.” Flowering occurs sometime during the second year of growth.

AGROFORESTRY AND ENVIRONMENTAL SERVICES

Agroforestry/interplanting practices

In the traditional system of shifting cultivation of Tonga, newly cleared lands are planted with yam, giant taro, and banana, or plantain. In general this system uses a 6-year crop rotation cycle (Pole 1993):

yam and giant taro	8–12 months
sweetpotato	5–6 months
Colocasia or *Xanthosoma* taro	8–12 months
cassava	6–8 month
bush fallow	2–4 years

More recently, *Colocasia,* maize, and other leafy vegetables are frequently included in intercropping with yam. Cassava is grown last in the cycle because it is known to do better in soils of low fertility.

On Fais Island giant taro is often interplanted with *Colocasia esculenta* in newly cleared garden sites.

Environmental services

The large leaves protect the soil from erosion and are an excellent source of organic matter for mulch or compost.

Top left: Young giant taro planting in a recently cleared slash-and-burn garden on Basakana Island, Northern Malaita, Solomon Islands. Most likely, high population pressure on Malaita’s land resources has forced some Malaitans to make gardens in bare limestone rock. December 1981. Top right: Young, 3–4-month-old giant taro garden planted in very stony soil toward Yiyelet, Fais Island. The soils of this area and much of the central plateau of Fais belong to the Peleliu series. Soils of this series range from extremely cobbly silt loams to rock outcrops of limestone. July 2009. Bottom left: A close up photo of young, 3–4-month-old giant taro from garden at Yiyelet, Fais Island. July 2009. Bottom right: A single taʻamu taro growing on the mulched, raised taro beds on Aunuʻu Island, American Samoa. This taʻamu planting is unusual as the species does not favor waterlogged or swampy soils. December 1989.

Left: Large 2–3-year-old giant taro at the edge of an agroforest on Falalop Islet, Ulithi Atoll, Federated States of Micronesia. Patches of *Colocasia esculenta* and *Cyrtosperma chamissonis* taro can be seen in the foreground. December 1989. Top right: Mixed open canopy garden at Buma, Malaita, Solomon Islands. The main components of these gardens are sweetpotato, yam, pineapple, and giant taro. *Colocasia* taro is not found in this 1–2-year-old garden because of *Phytophthora* leaf blight. December 1980. Bottom right: *Ta'amu* in a breadfruit-banana agroforest near Taga, ʻUpolu, Samoa. December, 2003.

PROPAGATION AND PLANTING

Giant taro is easily propagated by cormlets or suckers. In Wallis, the underground lateral suckers (*mata kape*) are used (Nozières 1982). In Tonga, the preference is for large suckers; in times of shortage, cormlets are used and their location in the field is marked by a coconut frond. Suckers are planted in holes 15–25 cm deep while cormlets are planted in shallower 8–15 cm holes (Holo and Taumoefolau 1982). Fertilizers are seldom used. In Wallis, humus, ash and decomposed leaves are mixed into the soil before planting. There is little attempt to control insects or mealybugs. Fungal diseases are likely if the soil is too wet or infertile.

On Fais Island, the petiole and the top 3 cm of the stem of harvested giant taro (*paag*) is often replanted in the same garden plot. Suckers are also used as planting materials.

CULTIVATION

Variability of species and known varieties

The species is highly variable in yield and growth characteristics. There are four varieties in Tonga (Prescott and Folaumoetuʻi 2004). *Kape hina* is the most popular and most commonly cultivated variety, but *Kape ʻuli* and *Fohenga* are more popular in the Vavaʻu group where the climate is warmer and wetter. *Kape ʻuli* and *Fohenga* have purple flesh and are sometimes mistaken for each other. The fourth variety *Kape fulai* has a high irritant content.

On the upraised limestone island of Fais, giant taro is the most dominant aroid grown there. Fais Islanders recognize ten varieties of cultivated giant taro: *Fila loi, Fila peyaliu machingaloi, Fila loilemalthew, Fila angaur, Fila euripik, Fila osi, Fila yapsech, Fila moli, Fila woleai, Fila yalus*, and *Fila peyalai*, an uncultivated variety (Manner 2009). *Fila woleai* is said to be very tasty.

Cable and Ashgar (1984) say that twelve varieties of giant taro, 85 varieties of *Colocasia esculenta*, and ten varieties of *Cyrtosperma chamissonis* (often considered syn. *C. merkusii*) have been recorded for Samoa.

Basic crop management

Because of its shallow rooting system, weeding is required to reduce competition for nutrients. In Tonga, weeding is done fortnightly with a hoe. In Wallis, the bush knife, crowbar, and yam spade are the usual tools. On Fais Island, hilling (increasing the height of soil around the roots and lower stem) of giant taro during the second year of growth is practiced.

Carbaryl, malathion, and diazon are used to control black cutworm (*Agrotis ipsilon Aneitura*), taro sphinx moth (*Hippotion celerio*), and cluster caterpillar (*Spodoptera litura*) in Tonga. Diseases caused by *Cladosporium colocasiae* and *Mycosphaerella colocasiae* are minor and do not warrant chemical control (Holo and Taumoefolau 1982).

Special horticultural techniques

No special horticultural techniques are required for commercial production.

Advantages and disadvantages of growing in polycultures

Polyculture provides better protection from pests and diseases, an extended harvest period (because of the different rates of maturation), more efficient use of vertical space, and greater weed suppression, among others. As different crops have different nutrient requirements, polyculture makes more efficient use of soil nutrients and provides farmers with greater nutritional and dietary diversity from the same garden site. Disadvantages may include reduced photosynthesis of shorter crops because of shading effects and a reduced production of taro per area of cultivated land.

According to Brooks (2004: iv) "Few plant disease epidemics have been recorded in American Samoa. This is partly due to traditional agroforestry practices. These practices include interplanting small areas of subsistence crops taro, giant taro, tapioca, kava among banana, breadfruit, coconut or forest trees. One recent exception was the 1993–1994 taro leaf blight epidemic caused by *Phytophthora colocasiae*. Taro (*Colocasia esculenta*) was a major crop in both American Samoa and independent Samoa, planted over large areas of the islands. When *P. colocasiae* arrived it rapidly spread through the susceptible Samoan cultivars. Establishment of leaf blight resistant taro from Micronesia in 1997 has revived local production. Currently, breeding lines from Southeast Asia and the Pacific are being introduced to improve eating quality and increase genetic diversity."

PESTS AND DISEASES

Susceptibility to pests/pathogens

Giant taro is resistant to most pests and diseases (Kay 1987). Pests of giant taro in Tonga include the black cutworm (*Agrotis ipsilon Aneitura*), taro sphinx moth (*Hippotion*

Left: Giant taro in banana-mango agroforest in Samoa. April 2003. Giant taro growing under coconuts and other trees on Nukuʻalofa Island, Tonga. December 2006.

celerio) or cluster caterpillar (*Spodoptera litura*). Diseases caused by *Cladosporium colocasiae* and *Mycosphaerella colocasiae* [sic] are minor (Holo and Taumoefolau 1982). Nozières (1982) wrote that leaf-blotching and rotting of the tubers are more likely to occur if the soil is poor or too wet.

The list of diseases by Brooks (2004) includes:

Cercospora sp.	leaf spot
Colletotrichum gloeosporioides	leaf spot
Glomerella cingulata	anthracnose
Macrophoma sp.	from taro leaf blight lesion
Mycosphaerella alocasiae	leaf spot
Pestalotiopsis sp.	from leaf spot
Phoma sp.	from leaf spot
Phytophthora colocasiae	taro leaf blight

Pest and disease prevention

An extensive list of traditional Samoan methods for preventing and treating problem pests and diseases and the farmer's perception of control method effectiveness (Tikai and Kama 2004) is presented in Tables 2 and 3. The data show that intercropping, good crop sanitation and hygiene,

Top left: 1½-year-old giant taro plot in a clearing in the agroforest on Falalop Islet, Ulithi Atoll. June 2008. Top right: Remnant 2–3-year-old giant taro in older subsistence garden under coconuts on Rotuma Island, Fiji. July 1983. Bottom left: Open canopy garden of 1–2-year-old giant taro and remnant *Colocasia* taro at Welbuger, Fais Island. This garden is between 2–3 years of age. June 2008. Bottom right: Another view of the open canopy garden at Welbuger. The agroforest was cut and cleared 3 years prior. June 2008.

removal of diseased plants and leaves, fallowing, and shifting cultivation are some of the sustainable practices of controlling pests and diseases. Less effective methods are scaring devices for vertebrates, using treated sand, bush burning and smoking, and using resistant varieties. In contrast to the other crops (taro, yam, and bananas) the usage frequency of all traditional control methods is the least for giant taro, and much higher for *Colocasia* taro and yams(*Dioscorea* spp.).

DISADVANTAGES

Several cultivars of giant taro are reported to be cyanogenic (capable of producing toxic cyanide); the cyanogenic glycoside is not present in the corms or stems, but the young leaves have been found to contain up to 0.018 per cent of hydrogen cyanide and much of the calcium is in calcium oxalate crystals (Kay 1987).

While the species has naturalized outside of its native range, it does not seem to be a pest. Most varieties found in the wild are often perceived to be inedible. Cultivated varieties do not seem to have invasive qualities; however, further evaluation is required. Pacific Island Ecosystems at Risk (PIER 2010) lists giant taro as an invasive or potentially invasive species.

COMMERCIAL PRODUCTION

Postharvest handling and processing

Postharvest handling and processing methods are similar to those used for *Colocasia* taro.

Product quality standards

While there are no international standards, it is sensible that only cleaned, high quality stems, free of soil, parasites, pests, roots, rot, and other problems, are exported in order to reduce treatment and other handling costs. Most developed countries have strict phytosanitary certificate regulations and requirements for Pacific island countries that export giant taro and other aroids (e.g., New Zealand 2001). Opara (n.d.) also suggests good packaging and evidence of a quality assurance system to meet the importer's requirements.

Storage requirements and shelf life

The stems must be used within a month of harvesting as they are subject to rotting. Opara (n.d.) notes that corms destined for storage should be cleaned but not washed, and cured (air dried) to enhance repair

Table 2. Traditional Samoan methods of control of pests and diseases of taro, yam, ta'amu (giant taro), and banana (n=30).

Indigenous control methods	Frequency of use							
Activity	Taro	%	Yam	%	Ta'amu	%	Banana	%
Sanitation (hygiene)	10	33	23	77	15	50	17	57
Burning and smoking	5	16	6	20	1	3	10	33
Use of resistant variety	24	80	15	50	1	3	3	10
Varietal mixture/inter-cropping	20	67	24	70	14	47	5	17
Roguing (removal) of diseased plants and leaves	25	83	21	70	3	10	16	53
Use parts as repellent/or attractant	24	80	3	10	1	3	–	–
Dusted planting materials (ashes)	10	33	26	87	2	7	–	–
Dusted planting materials (sand)			5	17	–	–	–	–
Hand picking and squashing of beetles	15	50	15	50	5	10	1	3
Fallowing and shifting cultivation	23	77	17	57	6	20	1	3
Using physical barriers	5	17	6	20	1	3	7	23
Selection of planting materials	25	83	20	67	2	7	20	67
Drying of setts prior to planting	–	–	12	40	–	–	–	–
Manipulation of planting season	22	73	9	30	1	3	–	–
Scaring devices for vertebrate pests	1	3	1	3	1	3	5	17
Slash and burn	11	37	1	3	3	10	14	47

Source: Tikai and Kama 2004.

Table 3. Frequency distribution of respondents ranking of the effectiveness of traditional Samoan control methods for taro, yam, ta'amu (giant taro), and banana (n=30).

Control methods	Not effective	%	Effective	%	Very effective	%
Sanitation	7	23	17	57	7	23
Bush burning and smoking	16	53	8	27	4	13
Use of resistant variety	15	50	16	53	–	–
Varietal mixture/or intercropping	4	13	24	80	2	7
Roguing (removal) of diseased plants & leaves			27	90	5	17
Shifting cultivation, fallow	11	37	19	63	5	17
Use of plants as repellants	6	20	4	13	–	–
Treated materials (ashes)	12	40	17	57	1	3
Treated materials (sand)	19	63	3	10	1	3
Scaring devices for vertebrates	20	67	1	3	–	–

Source: Tikai and Kama 2004.

of physical injury. Stems should be dry so as to prevent the spread of microbial growth. In Tonga, giant taro stems can be stored for 3 to 5 months if kept in a cool, dry, and dark shed (Foliaki 2010).

Recommended labeling

Stems should be labeled with country of origin, variety, cooking instructions (as it is not a well known starch crop), and required nutritional information.

SMALL SCALE PRODUCTION

Commercial production of this crop in small plots or farms less than 0.5 ha should not require any special techniques, as most of this crop is presently produced for subsistence and commerical consumption in small plots.

Household use in the Pacific

Giant taro is an important aroid in Samoa and American Samoa, Wallis, Tonga, and the upraised limestone island of Fais, and a few Micronesian atolls. In Tonga, the consumption of *Xanthosoma* and *Colocasia* taros, sweetpotato, yam, and cassava is greater than giant taro. Annual production of giant taro stems of approximately 1500–2000 MT is common in Tonga (Foliaki 2010). Table 4 shows the supply of giant taro and other root crops in the Talamahu market in Nuku'alofa, Tonga for the years 1987–1991 (Pole 1993).

In Samoa, giant taro ranks second to *Colocasia* taro. The number of agriculturally active households there was 17,829 (77%) out of 23,277 total households. The percentages of the agriculturally active households that sold *Colocasia*, *Xanthosoma,* and giant taro were 26, 4 and 8, respectively (Samoa 2002). The estimated value of giant taro sold in the market in 2002 was $T426,000. The percentage of households that consumed giant taro was 41% with average weekly consumption per household of three pieces. In Guam and the Mariana Islands, the species is considered to be inedible, although in almost all Pacific islands it is regarded as a famine food. On Fais Island, the giant taro ranks first among all aroids in volume and area planted. There the rank order of the other aroids is *Xanthosoma*, *Colocasia,* and *Cyrtosperma*.

Nutrition

The stem tuber provides good amounts of energy and high amounts of protein, iron, and manganese and low amounts

Table 4. Supply of root crops to Talamahu market, 1987–1991. Weight in metric tons.

Crop item	1987	1988	1989	1990	1991
Colocasia	14.22	17.51	30.55	201.44	169.83
Xanthosoma	324.70	208.75	447.56	1074.19	805.04
Alocasia	641.64	101.91	229.46	178.01	143.57
Yam	295.66	195.88	267.27	284.46	317.40
Cassava	648.21	671.42	630.82	353.36	397.36
Sweetpotato	742.60	362.44	734.63	1689.03	1649.52
Total	2667.03	1557.91	2340.29	3780.49	3482.72
Percent aroids to root crops	36.8	21.1	30.2	38.4	32.1

Source: Pole (1993). Note in the original article, weights are presented in tons.

Left: Homegarden planting of giant taro and *Colocasia* taro in Nuku'alofa, Tonga. April 2003. Right: A planting of giant taro in an old subsistence garden located on the upper bank of the Wainimala River in central Viti Levu, Fiji. In Fiji this species is less important than *Colocasia* taro. November 1980.

Left: Backyard garden on Savai'i island, Samoa. December 2006. Right: Mixed crop of beans and *ta'amu* on 'Upolu, Samoa. December 2006.

of copper, potassium, thiamine, and riboflavin (Bradbury and Holloway 1988). Recent data on the food composition of giant taro from the Pacific islands by Dignan et al. (2004) are presented in Table 5.

Import replacement

This crop is nutritionally better than cassava. Furthermore, because it can be harvested over a number of years, it is a ready source of carbohydrates and can easily replace imported rice and other starches.

YIELDS

According to Kay (1987): "In the Pacific islands harvesting is usually after 18–24 months but the plant may be allowed to grow for up to 4 years, producing corms weighing about 18 kg. Theoretically, yields for pure stands could be almost 200 MT/ha at this stage, but no yields for the Pacific region have been reported as all normal planting is intercropped. Much lower yields are reported from Sri Lanka, where harvesting is usually at 11 months, giving about 7–11 MT/ha per crop (1.8–2.7 kg per plant) though when grown over coconut husks 6–7 kg per plant is obtained."

Experimental trials by Foliaki et al. (1990) on six South Pacific cultivars of giant taro on Hawai'i's Hāmākua coast grown in pure stands showed considerable range in yield after one year's growth. A spacing of 1.2 m × 1.8 m (4 ft × 6 ft) was used. The cultivar *Tonga* had the highest average yield of 79.2 MT/ha (70,647 lb/acre) while the cultivar *Niu Kini* averaged 15.9 MT/ha (14,185 lb/acre). One trial block yielded 90 MT/ha thus supporting Kay's contention of a theoretical yield of almost 200 MT/ha at 4 years of growth. Characteristics of all six cultivars are presented in Table 6.

In a Tongan experimental study, year-old giant taro grown in Vaini clay at a spacing of 1.5 m × 1.5 m yielded 31 MT/ha, with individual stems weighing on average 7.3 kg (Holo and Taumoefolau 1987: 87).

Table 5. Nutrient composition of giant taro (per 100 g).

Preparation	Water	Energy	Energy	Protein	Total fat	CHO available	TDF	Na	Mg	K	Ca	Fe
	g	kcal	kJ	g	g	g	g	mg	mg	mg	mg	mg
Baked	68	111	463	2.3	0.1	24.4	2.0	33	57	290	41	0.9
Boiled	73	92	386	2.0	0.1	20.4	1.7	27	47	243	35	0.8
Raw	70	102	426	2.2	0.1	22.5	1.9	30	52	267	38	0.8

Preparation	Zn	Retinol	β-carotene equiv.	Total Vit A equivalent	Thiamin	Riboflavin	Niacin	Vitamin B_{12}	Vitamin C	Vitamin E	Cholesterol
	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg	mg
Baked	1.7	0	0	0	0.02	0.02	0.4	0.00	9.2	2.6	0
Boiled	1.5	0	0	0	0.01	0.01	0.3	0.00	8.5	2.2	0
Raw	1.6	0	0	0	0.02	0.02	0.5	0.00	17.0	2.4	0

Source: Dignan et al. 2004.

Recommended planting density

According to Kay (1987), giant taro is commonly intercropped with yam at a usual spacing of 3.5 × 3.5 m. In pure stands 60 × 60 cm to 1.5 × 1.5 m spacings are used. For Wallis Island, Nozières (1982:88) wrote: "Space between the plants varies from one to two metres if taro is interplanted between the giant taro; if giant taro is grown alone the plants are more closely spaced."

On Fais Island and Ulithi Atoll, spacing of 90 cm × 90 cm to 1.2 m × 1.2 m is used (Manner 2009).

MARKETS

Local markets

There is a small but potential market for this crop wherever there are significant populations of Polynesians and Micronesians. Foliaki et al. (1990) reported that giant taro was sold at Laie, Oʻahu.

Export markets

There is good potential for expanding the export of giant taro within the Pacific Basin and Rim (where there are many Polynesians). Tonga exports giant taro to New Zealand, Australia, and the West Coast of the U.S. mainland (Foliaki 2010), while Samoa exports giant taro to American Samoa. Currently, Tonga exports an average of 700 to 1000 MT of frozen giant taro stems and is planning to increase this amount 3–4 fold in the next 3–5 years (Foliaki 2010). The value of Samoan exports of *Colocasia* taro and giant taro to American Samoa is shown in Table 7. Table 8 shows the amount of produce sold in the American Samoan marketplace during the period 1996–2001.

Within the Pacific, an analysis by Samoa (2005) found export opportunities in American Samoa for taro, giant taro and other agricultural and marine products based on market sales and American Samoan imports by value. They concluded that there was a great opportunity for Samoa to export giant taro to American Samoa given the variable and limited amount of local production. An obstacle to expanding exports was a quota that limited imports to American Samoa.

Foliaki et al. (1990) conclude that there is a market for Hawaiian-grown giant taro but that cultivar selection is an important consideration. For example, the Tongan preference for cultivar *Tonga* and the high yield of that variety would be instrumental in its selection and marketing. The value of Tongan exports of giant taro, *Colocasia*, and *Xanthosoma* are presented in Table 9. In terms of export earnings, *Taro tarua* is first, swamp taro is second, and giant taro is third (Kingdom of Tonga 2006). It is also interesting that *Taro tarua* is the second most consumed starch in Tonga

Table 6. Yield and other characteristics of giant taro cultivars after one year's growth in experimental trials, Hāmākua, Hawaiʻi.

Characteristic	Tonga	Niu Kini	Fiasega	Laufola	Fiatama	Acc 18
Avg wt (kg)	17.64	3.53	4.76	5.58	4.53	16.13
Avg yield (kg/m^2)	7.97	1.62	2.16	2.51	2.07	7.28
Avg yield (kg/ha)	79,700	16,200	21,600	25,100	20,700	72,800
Height (m)	3.0	1.5	1.8	2.4	1.5	4.6
Breadth (m)	4.6	1.8	1.8	1.8–2.4	1.2	3.0
Largest stem length (cm)	104	51	46	61	46	102
Largest stem diameter (cm)	20	8	18	18	15	23
Largest stem wt (kg)	31.8+	10.4	9.1	14.5	9.1	38.1+
Color leaves	Green	Purple	Variegated green and yellow	Green?	Green?	Slightly purple lower petiole
Color stem flesh	White	Grey purple Veins purple	Yellow	White		White
Other characteristics	Most widely grown of cultivars Almost free of irritants. Favored by Tongans.	Generally a more horizontal leaf arrangement	Contains a higher level of irritants than the other cultivars. Could command a higher price because of stem color.	Leaves upright. Considered not a profitable cultivar because of white flesh and low yield.	Small stems. Produces many offshoots and better adapted to wetter conditions. Can be continually harvested without replanting.	Possible hybrid between Laufola and Tonga. Not recognized by South Pacific Islanders and thus may be difficult to market
Origin	Tonga, Wallis & Futuna	New Guinea	Samoa?	Samoa?	Samoa?	

Source: Foliaki et al. 1990. Values converted to metric units from the original.

Density, spacing, and other plot characteristics can be easily measured using 4 m × 4 m sample plots (quadrats). With a little instruction, farmers such as Meldin of Fais Island can quickly master the basics of quadrat establishment and analysis. June 2008.

Table 7. American Samoa agricultural imports for 1996–2002 (in $1,000).

Products	2002	2001	2000	1999	1998	1997	1996
Bananas	21,139	50,909	57,465	16,572	33,620		
Fresh fruits	187,172	314,441	431,035	389,414	574,571		
Giant taro	29,637	–	68,079	80,145	58,599	89,235	–
Taro	511,128	358,410	258,988	152,403	55,397	71,254	198,510
Fresh vegetables	601,893	676,540	48,988	403,312	500,578		

Sources: Table 9: Agricultural Imports, 1998–2002, Samoa (2005); Table 14.9: Value of Imports by Commodity: FY1996–2000, American Samoa (2000).

Table 8. American Samoa produce sold at the market, 1996–2001.

Item	2001	2000	1999	1998	1997	1996
Vegetables (MT)	64.4	65.8	103.4	62.6		
Fruits (MT)	50.3	82.1	532.1	518.0		
Taro (MT)	83.0	83.0	69.8	21.8	56.7	4.5
Yams (MT)	4.1	4.1	7.2	4.5	2.7	4.5
Green bananas (MT)	296.6		33.6	385.1		
Ripe bananas (MT)	19.5	19.5	3.2	25.4		
Breadfruit (MT)	41.3	44.0	67.1	63.5		
Other vegetables, each	–	–	–	1,995		
Giant taro, each	1,504	1,504	3,044	2,071	1535	1817
Luau, bundles		5,370	6,123	4,994	6,805	5,598
Mature coconuts, each	164,811	164,811	204,044	186,747		
Green coconuts, each	19,541	19,541	20,720	20,875		

Sources: Table 8: Agricultural Produce Sold at the Market Item, Samoa (2005); Table 13.11: Vegetables, Fruit, Coconuts, and Root Crops Sold at the Market: Fy1996–2000, American Samoa (2000). Produce weight converted to metric units from the original.

Table 9. Value of Tongan Taro Exports for 1992–2004 in T$1,000.

Commodity	1992	1993	1994	1995	1996	1997	1998
Giant taro (kape)	34	15.4	16.6	8.3	59.0	33.4	4.6
Swamp Taro	3.5	21.3	31.1	33.8	14.7	2.8	6.7
Taro tarua	115.2	104.7	85.1	79.2	125.7	159.4	31.1
Value of all vegetable products	13,895	20,237	16,281	16,677	11,937	1,233	7,487

Commodity	1999	2000	2001	2002	2003	2004
Giant taro (kape)	27.8	347.4	444.2	89.4	35.7	113.5
Swamp Taro	0.1	235.7	411.2	101.3	134.8	204.5
Taro tarua	30.2	511.2	894.9	448.7	131.2	245.3
Value of all vegetable products	16,610	8,540	10,557	17,233	23,762	21,422

Source: Kingdom of Tonga (2006)

(cassava is first) and has no value as a presentation crop (Pole 1993).

Potential for Internet sales

The short shelf life, distance from major metropolitan markets, increasing costs of transportation, small overseas market, and limited knowledge of the crop limits its potential as fresh produce marketed and promoted via the Internet.

EXAMPLE SUCCESS

What is a successful farmer? To many of us, this may be a semi-commercial or commercial farmer who sells some or all of his/her agricultural produce for a living. Teddi Laub of Ilothow (Yiludow) Village, Fais Island is a subsistence farmer who grows food for her family and close relatives. She, like the majority of subsistence farmers throughout the Pacific, rarely sells any of her produce in the marketplace. Rather she often exchanges food and other things she makes with her relatives and friends. Her male relatives on the island often supply her with fish and other seafoods.

Fais is an isolated, small (only 1.9 km^2) upraised limestone island in Yap. The island has no electricity, supermarkets, or flush toilets and is home to about 310 people. Unlike most of the islands of the Pacific, the dominant aroid grown on Fais is giant taro. Both *Xanthosoma* and *Colocasia* taros are second and third in importance and *Cyrtosperma* taro is a distant fourth and limited to a few square hundred meters in area.

As in many traditional agricultural systems, cultivar diversity is a characteristic of the Fais agricultural system. The number of native named cultivars is quite large. Teddi and her husband Jessie Rangailug (deceased 2010) can name eleven varieties of giant taro (Manner 2009). Other food species with large numbers of varieties are seeded Micronesian breadfruit (*Artocarpus mariannensis*) (4), breadfruit (*Artocarpus altilis*) (12), coconut (*Cocos nucifera*) (9), *Colocasia* taro (12); sweetpotato (*Ipomoea batatas*) (27), bananas (16), *Xanthosoma* taro (6), cassava (9), and yam (*Dioscorea alata* and *D. esculenta*) (8 each). Other sustainable agricultural practices are fallowing, crop rotation, and interplanting or polyculture. Fais Islanders do not use pesticides or artificial fertilizers, or fossil fuel based farm machinery. Simple hand tools such as hoes, spades, digging sticks, and bush knives are used instead.

Teddi Laub, an example of a successful farmer of Harachui *bogota*, Fais Island, is pictured here with her husband Jesie Rangailug (deceased 2010). Like most Fais Islanders, Teddi practices sustainable agriculture. July, 2009.

Preliminary observations indicate that Fais agriculture is extensive in terms of the ratio of labor to land. Teddi's gardens and agroforests are scattered throughout the western side of the island, all within a maximum walking distance of 20 minutes. Her planting schedule is timed so that in addition to breadfruit, she has an almost continuous supply of food throughout the year. Teddi has access to other agroforests and gardening areas on the eastern side of the island, but does not cultivate these as the distance is a "bit far." All of her gardening sites are located on fairly level land where soil erosion is minimal to zero. The soils are mainly Entisols, recent sandy soils to stony soils of moderate fertility.

Teddi Laub's life is neither unique nor easy. She is one of many Pacific islanders who live in the more rural and often remote parts of the Pacific with limited access to money. Yet, she and some 50–65% of all Pacific islanders are able to feed themselves using the techniques and methods of an essentially sustainable traditional agriculture.

ECONOMIC ANALYSIS

There is little information on the production costs of this species, as it is mainly a traditional subsistence rather than commercial crop. The major cost is labor for preparation and selection of planting material, land preparation, planting, weeding, and harvesting. Land rent, machinery, fertilizers, and pesticide costs are minimal to nil. Commercialization of this crop may require fertilizers and pesticides.

FURTHER RESEARCH

Potential for crop improvement

Of the aroids, giant taro has been little studied. As Cable and Ashgar (1984) have noted with respect to the lack of data on the growth and comparative quality of Samoan giant taro varieties, it stands to reason that there is a tremendous potential for increasing the productivity. Indeed, Chandra's (1984) recommendations for more work on the agronomy, production systems, germplasm and breeding, diseases and pests, storage, utilization, and marketing of all taro are particularly appropriate to this species. As this species can grow in a wide range of soils and substrates, more research can greatly benefit its cultivation on the atolls and upraised islands of the Pacific.

Improving potential for family or community farming

Along with *Xanthosoma*, this species has a great potential for increasing the food resources of subsistence and semi-subsistence families throughout the islands especially if high yielding cultivars are used.

GENETIC RESOURCES WHERE COLLECTIONS EXIST

Cable and Ashgar (1984) noted then that a fairly complete collection of eleven Samoan *ta'amu* cultivars were planted at the University of the South Pacific's Moamoa Farm in Samoa.

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OTHER RESOURCES

Internet

New Zealand Digital Library: http://www.nzdl.org/fast-cgi-bin/library?a=p&p=home&l=0&w=utf-8

Or

Food and Nutrition Library 2.2: http://www.nzdl.org/fast-cgi-bin/library?a=p&p=about&c=fnl2.2

Specialty Crops for Pacific Island Agroforestry (http://agroforestry.net/scps)

Farm and Forestry Production and Marketing Profile for Giant Taro (*Alocasia macrorrhiza*)

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