Taro Production in Western Samoa Potential Marketing Outlets and Problems in the Region

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Taro is the main food item to the Samoans and in most South Pacific Countries as rice is to Asia or the Irish Potato is to Europe.

Taro production in Samoa still follows the traditional system of cultivation. However, the decreasing area in forests, the decline in soil fertility on cleared lands, the need to increase production on areas close to the village plus the demand for export and the advent of new farming methods has led to commercial cultivation.

The migration of people to New Zealand, Hawaii and the U.S. mainland plus periodic taro shortages within countries of the region, has created a lucrative export market for taro as a useful earner of foreign exchange to the country.

More than 80% annual taro production is consumed locally while the export market has averaged from 60-100,000 cases (60 lb case) over the last six years (Table 1) and valued at some $1 million dollars.

Traditional Cultivation of Taro

While both dryland and wetland taro are grown in Samoa, the majority are grown under dryland conditions and depend upon rainfall for water supply.

Taro is usually grown in areas where soils are of moderate to high natural fertility. Usually, it is the first crop in a rotation and planted in areas recently cleared in the bush fallow system. Taro is planted in rich organic mulch in holes made with digging sticks. Spacing varies but is usually wide at 4' x 4' or 3' x 3' (120 x 120 cm or 90 x 90 cm). Taro is left in the ground depending upon soil fertility, climate and time of year, individual preference and variety. Usually, corms are harvested after 6-12 months with mean time in the ground being from 7-9 months. However, some cultivars like taro Manua may be left for up to 15 months. Individual taro are commonly in the 3-5 lbs (1.35-2.25 kg) size range which suggests that per acre yields are usually in the 5-10 tons/acre (12.5-25.0 metric tons/hectare) range.

As the natural fertility of the soil decreases fairly rapidly after clearing the bush or natural forest, only one or usually two crops of taro can be grown before a different crop in the rotation is planted or the land is left fallow and taro planting moved to a new area. As areas of bush are used up, taro growing has tended either to move inland from the village or grown on exhausted land so that yields decline to where average yields are in the 1-5 tons/acre (2.5-12.5 metric tons/ha) range with average yield probably about 2-3 tons/acre (5-7.5 metric tons/ha).

Intensive Cultivation

Work in a number of countries has shown that taro yields can be considerably

increased through the introduction of new cultural and management practices. Thus in Hawaii, maximum yields are obtained at planting densities corresponding to a spacing of 30 x 30 cm. In order to maintain or increase taro yields in Samoa and reduce labor inputs, fertilizer and herbicide use are being introduced. However, these changes in production methods such as spacing, while increasing total yield may result in somewhat smaller corms than present general consumer preference and may result in increases in certain pests and diseases.

In general, with closer spacing, total corm yield increases but average individual corm size decreases. Adoption of more intensive production systems will mean that people will have to accept new methods and techniques, and also be prepared to adjust their preferences to the somewhat smaller average corm size, probably in the 1-2 lb (450-900 g) size range.

Some Significant Factors in Taro Cultivation

Traditional belief still holds that skill in the use of the 'oso' (digging stick) determines the shape, size and to a large extent the quality of taro. Planting holes are made using wooden or metal planting sticks being moved from side to side to loosen the soil.

Holes are usually 10-25 cm in depth depending on the size of planting material, type of area and individual preference.

High yields are obtained when planting coincide with the rainy season from September to December. However, continuous supply is obtained by regular monthly plantings to meet the expected domestic and market requirements.

The main cultivars used in Samoa are:

Taro Manu'a (Purplish white)
Taro Niue (Pink type)
Taro Pa'epa'e (Whitish type)
Taro Palagi (Xanthosoma)

Taro Niue and Manu'a are the most widely planted. Selected cultivars influence optimum spacing, time to harvest and yield. Consumer preference and market demand for export is for taro Niue.

The size of planting material has an effect on yield. It is generally accepted and supported by trial evidence that larger planting materials produce larger yields.

The following notes on Fertilizer Use and Application are the result of recent work done by Dr. Steve Reynolds at USP (Alafua).

(a) **Fertilizer Use.** Although it has been suggested that taro grown with the use of fertilizer are soft, watery and less tasty than the hard taro produced where no fertilizer is used, evidence suggests that this only occurs when fertilizer is applied too late in the growth cycle, stimulating leaf production and vegetative growth at the expense of corm formulation. The phenomenon was known long before fertilizer was first used and is probably also caused by climatic factors like heavy rain just before harvesting. In order to avoid any fertilizer effect on the taro, at least 3 clear months should be allowed between the last fertilizer application and harvesting. Thus, for taro to be harvested after 7 months, no fertilizer should be applied after about the fourth month, or at the time of maximum leaf canopy. Fertilizer use may both increase yields and reduce time to harvest.

(b) **Fertilizer Application**

i. Apply 1 lb (450 g) of fertilizer per 25 taro plants at 1½ months and again at 3 months after planting. The fertilizer can be broadcast over the whole area or spread along each row. Application should be done when leaves are dry so that fertilizer burns do not occur. Amount of fertilizer per acre = 175.5 kg (90 x 90 cm spacing) and 398 kg (60 x 60 cm spacing).

ii. Foliar sprays – fortnightly 5% urea foliar sprays, starting after 2 weeks and continuing for another seven applications until the sixteenth week, have given a good response at a rate of 6.8 kg urea/30 gallons water/acre. Foliar sprays are best applied in the early morning or late afternoon; application should give a uniform coverage of the leaves avoiding excessive wetting which can cause leaf scorch problems.

(c) **Disease Control.** Insects which may cause damage include taro army worm (*Spodortera litura*) taro leaf hopper (*Tarophagus proserphina*) and taro hawk moth (*Hippotion colerio*). However, severe infestation warranting specific control measures may occur only infrequently, particularly in dry periods. The recommended control measure is .1% spray of trichlorphon (Dicidex).

Where intensive taro cultivation is undertaken, a more important problem is likely to be root nematodes (*Helicotylenchus* sp., *Rotylenchus reniformis* and *Xiphinema ensiculiferum*), but little information is available at present. Also, it is thought that leaf-spot diseases e.g. *Phylosticta* sp.) are likely to increase rapidly with closer spacings and more intensive production methods. These are likely to require regular spraying programs with Maneb or Benlate.

Yields

Using traditional methods on soils newly cleared from bush areas and a spacing of 90 x 90 cm or wider, taro harvested after 7-9 months generally produce taro in the 1.35-2.25 kg size range with per acre corm yields of 5-10 tons/acre. Yields may be increased by a further 50% if all sucker corms (cormels) are also harvested as a ratoon crop some 3-4 months later.

Using spacing of 90 x 90 cm or 60 x 60 cm, similar yield will usually be achieved on poorer land where fertilizer and weedicides are used. Trial work has shown that these yields can be achieved although with smaller individual corm sizes, but it must be stressed that best response to fertilizer use was always found where soil organic matter content was highest.

The Economics of Taro Production

The following situations were analyzed: a) growing of taro in the traditional way without chemical inputs, but on good fertile land; b) traditional way without chemical inputs on soils with low to moderate fertility and c) growing of taro with application of fertilizers, chemical weed control and pest and disease control.

The economic calculations are summarized in Table 2. The conclusions based on these calculations show that the traditional system is the best where fertile land is available. In land-short villages where the bush fallow has become far too short, we find situation 2 with low yields, this is where fertilizer use should be recommended. As seen

in example 3, the economy of such an operation is good in spite of the bigger inputs of chemicals and labor.

Market Outlets and Related Problems

The migration of Samoans and other Polynesians to N.Z. and U.S.A. has created a demand for the export of taro to those countries. These people are used to eating taro and are prepared to pay high prices for it. Over the recent years, export of taro (Table 1) has increased although local demand itself, shipping problems and varying prices from overseas have affected a still greater increase in export volume. The NZ market demand is estimated at around 70,000 cases per month while the less predictable USA market demand is estimated at around 10,000 bags per month. Both these markets are supplied by countries of the region which often compete and tend to affect overall prices.

Export of taro to neighboring islands is hindered by quarantine restrictions. Island Governments tend to be protective towards their farmers' interests. However, American Samoa is a profitable but a limited market because of its land shortage and high standard of living.

Transportation is the major problem for the NZ and US markets. Available shipping is irregular and often takes too long so that the keeping quality of taro deteriorates very quickly if beyond a week. Air freight is being used for the US but the high cost involved, makes taro prices expensive.

Furthermore, the development of a staple export market is compounded mainly by the instability in the local market. This instability in the local market is due to periods of acute shortages when prices rises rapidly and periods of oversupply when prices are depressed below the costs of production.

Hence, alternative use of taro is being investigated in Western Samoa mainly in response to stimulus of widely fluctuating market prices for taro. Research has centered on the development of products based either solely or partly on taro flour or cooked frozen taro and taro slices. A list of taro products which have been processed at Alafua Food Processing are as follows: 1) Taro flour, 2) Taro-based baby weaning food, 3) Taro-based breed, 4) Frozen taro slices with coconut cream, 5) Frozen baked taro, and 6) Frozen baked taro slices.

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Table 1. Taro exports for Western Samoa (1973-1978 Jan-May)

Year	Quantity	Country	Value (WS$)*
1973	66,465 cases	N.Z.	–
	3,790 sacks	Am. Samoa	–
1974	22,269 cases	N.Z.	119,912
	438 sacks	U.S.A.	2,720
1975	23,887 cases	N.Z.	203,039
		U.S.A.	
	36 cases	U.S.A.	–
	40 sacks		
1976	64,828 cases	N.Z.	526,720
	3,380 bags	U.S.A.	23,800
1977	27,380 cases	N.Z.	410,700
	3,077 bags	U.S.A.	27,693
1978	81,520 cases	N.Z.	1,300,000
	25,240 bags	U.S.A.	
1979	(August 31, 1979)		
	65,620 cases	N.Z.	–
	20,925 bags	U.S.A.	

* $ (U.S.) .80c (W.S.)

Table 2. Summary of calculation for 1 acre of taro

Cost and returns	A*	B*	C*
Spacing	3' x 3'	3' x 3'	2' x 2'
Tiapula planted per acre	5,000	5,000	10,890
Corms harvested per acre	4,000	4,000	9,000
Weight per corm harvested	2.5 lbs	1.5 lbs	1.5 lbs
Yield per acre	10,000	6,000 lbs	13,500 lbs
Price per lb	$ .07	$.07	$ .07
Gross return per acre	$700	$420	$945
Cost of material per acre	$150	$150	$388
Net return per acre using family labor	$550	$270	$557
Labor days required (mandays)	80	80	75
Net return per manday	$6.88	$3.38	$7.43
Net return per acre using hired labor	$390.00	$110.00	$407.00

*A The growing of 1 acre of taro on soils of high natural fertility, but without use of fertilizers chemical weed control and pest and disease control.

*B Ditto, but on soils with low to moderate fertility.

*C With application of fertilizers, chemical weed control and pest and disease control.

Annex 1. **Taro production on a per acre basis on high and low fertility soils, without fertilizers, chemical weed control, pest and disease control application: costs and return A and B**

1	Spacing 3' x 3'
2	Plants per acre 5000
3	Because of losses from pests and diseases, stealing of corms, etc. the actual number of plants harvested per acre is estimated at 4000.
4	Soils: A/ High natural fertility B/ Moderate to low natural fertility
5	Yields per acre: 4000 xoema od A/ 2.5 lbs per corm, i.e. 10000 lbs/acre B/ 1.5 lbs per corm, i.e. 6000 lbs/acre
6	Price: An average price of $.07/lb is assumed based on average prices present years.
7	Gross return per acre: A/ 10000 lbs @ $.07/lb gives $700/acre B/ 6000 lbs @ $.07/lb gives $420/acre
8	Production costs: materials: A/ and B/: $150.00 per acre No fertilizers, chemical weed control, pest and disease control are applied. Cost of planting material (tiapula): A/ 5000 @ $.03 i.e. $150.00 B/ Ditto Although costs are included for tiapula, normally a grower would have his own, or at least once purchased he would have sufficient for further plantings.
9	Net return per acre excluding cost of labor A/ $700 – $150.00 = $550.00 B/ $420 – $150.00 = $270.00

10 Labor required A and B per acre

Operations	Mandays
Clearing	16
Planting	10
Maintenance	40
Harvesting and transportation	14
Total	80

11 Cost of Labor per acre

80 mandays @ $2.00 $160.00

12 Net return per manday: A $6.88

B $3.38

13 Total production costs with hired labor

	A/	B/
Cost of material inputs	$150.00	$150.00
Cost of labor	160.00	160.00
Total costs of production	$310.00	$310.00

14 Net return per acre: labor + material costs accounted for

	A/	B/
Gross return	$700.00	$420.00
Total costs of production	310.00	310.00
Net return	$390.00	$110.00

Annex 2. **Taro production on a per acre basis, using fertilizers, chemical weed, pest and disease control costs and returns C**

1	Spacing 2' x 2'	
2	Plants per acre 10890	
3	Actual plants harvested per acre 9000	
5	Yields per acre: 9000 corms/acre weighing 1.5 lb average gives a yield of 13500 lbs.	
6	Price: An average price of $.07/lb is assumed.	
7	Gross Return per acre: 13500 lbs at $.07/lb gives $945.00	
8	Production costs, Material inputs only per acre	
	A Planting Material	
	10890 tiapula at $.03	$327.00
	– (See note on planting material in Annex 1)	
	B Fertilizers	
	12 bags NPK fertilizer at $2.00/50 kg bag	$ 24.00
	C Weed control	
	2 gallons weedicide (Gramoxone) at $14.00	$ 28.00
	(This assumes a slightly higher than normal application rate because of terrain and site problems)	
	D. Pest control	
	a) Leafhopper and army worm control	
	When needed may require on average two applicatinos per crop of .1%	
	trichlorphon (Dicidex) – 1 pint at $2.85/pint	$ 2.85
	sticker ½ pint at $1.80/pint	$ 0.90
		$ 3.75
	b) Nematode control	
	Insufficient information available to make recommendations or costings	
	c) Leafspot Diseases	

	Insufficient information available to make recommendations or costings but this may eventually increase the cost of pest and disease control by a factor of between five and ten		
	E	Maintenance and depreciation of equipment	$ 5.00
		Total cost of production	$ 388.00
9	Net return per acre cost of materials accounted for		
		Gross return	$ $945.00
		Production costs (materials)	388.00
		Net return	$557.00
10	Labor required		
		Operation	Mandays
		Clearing	15
		Planting	20
		Maintenance	20
		Harvesting	20
		Total	75
11	Cost of labor		
		75 mandays @ $2.00	$150.00
12	Net return per manday		$ 7.43
13	Total Production cost per acre		
		Cost of materials	$388.00
		Cost of labor	150.00
		Total	$538.00
14	Net Return per acre labor + material costs accounted for		
		Gross Return	$945.00
		Total production costs	592.00
		Net Return	$353.00

Assuming that the first taro crop is harvested after 8 months and the ratoon crop after 6 months, we have a total growing period of 14 months during which the following costs and returns occur.

Summary of calculations for one main crop plus one ratoon crop of taro, 1 acre.

	A	B	C
Yield per acre, lbs.	19000	10500	23500
Gross return per acre, $	1330.00	7735.00	1645.00
Costs of materials per acre	150.00	150.00	425.00
Net return per acre using family labor	1180.00	585.00	1220.00
Mandays required	120.00	120.00	114.00
Net return per manday	9.83	4.88	10.70
Net return per acre using hired labor	940.00	345.00	992.00

These are very good results which may be difficult to achieve with other crops. In all the calculations shown, the amount of money at the line "Net return per acre using family labor" is the return the farmer gets for use of land, labor and his own management. In "Net return per acre using hired labor" the amount shown is the farmer's return for use of land and for the management. The labor here cost at $2.00 per manday.

When the main crop of taro is followed by a ratoon crop from the side suckers, the economic picture changes considerably, because although the ratoon crop yield is likely to be smaller (although not always so) the period in the ground is likely to be shorter, and labor inputs and cash costs less. As seen in Table 2 the net return is good. Thus a ratoon crop is to be recommended.

Table 3. Ratoon crop, summary for 1 acre

Cost and Returns	A	B	C
Yield per acre, lbs.	9000	4500	10000
Gross return per acre, $	420.00	315.00	700.00
Costs of materials per acre	0	0	37.00
Net return per acre using family labor	420.00	315.00	663.00
Mandays required	40	40	39
Net return per manday	$ 10.50	7.88	17.00
Net return acre using hired labor	332.00	235.00	585.00

In the above table for yields per acre, it is assumed that only 1 ratoon crop is harvested and that in A and B 4500 pounds are harvested and 10,000 in C.

Estimated manday requirement for ratoon crop, 1 acre

	A	B	C
Thinning and replanting (i.e. planting where gaps occur)	4	4	6
Maintenance	25	25	15
Harvesting	11	11	18
Total	40	40	39

Estimated costs for ratoon crop, 1 acre

	A	B	C
Fertilizers, 8 bags	0	0	16.00
Gramoxone, 1 gallon	0	0	14.00
Leafhopper and army worm control	0	0	3.75
Maintenance of equipment	0	0	3.00
Total			$37.00