

1st Draft

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**Taro Cultivation Improvement
Gadhdhoo, Maldives**

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Executive Summary

Farmers on Gadhdhoo, South Huvadho Atoll, cultivate taro in two large swamps on the adjacent uninhabited island of Gan and have been doing so for many generations. Corms are consumed locally, exported to Male or processed into chips for sale in capital islands.

Visits were made to Gan, 19-27 July 2008, to determine factors limiting cultivation and post-harvest practices, the intention being to advise, where appropriate, on needs for improved methods of cultivation, new varieties, flood control and post-harvest technologies, including marketing. A water control engineer was to accompany the mission to advise on flood control, but no one was available locally.

Methods of cultivation

The system of cultivation on Gan is unique. Wetland cultivation is practiced in other countries, but relies on the horizontal movement of water. Without this, waterborne fungi are often a serious problem causing corm and root rots. On Gan, this is not so, the swamp is closed; movement of water is vertical, the effect of tides and monsoonal rains; however, in general, the plants are very healthy.

There are four varieties grown. Each farmer has several small plots at different ages in order to have a continuous supply of corms throughout the year. Seasonal differences are not recognised. Taro are planted at close spacing and harvested at 6 months. Tops, petioles plus small corm piece or suckers are the planting material, pushed into the mud, often immediately after harvest. Organic amendments are used by some farmers and recognised to be beneficial by most, but the hard work needed to incorporate them is a disincentive. It is mostly the older people in the community who grow taro.

Factors limiting production

Farmers recognize a whitefly and flooding as the two major factors affecting production. Neither was seen during the visit. Whiteflies are most common during dry times and flooding during the monsoon, June to August, but also at other times, December in particular. There have been previous attempts to flood control with canals dug in the 1960s – two on the west side and one on the east of the island - but they were not maintained and abandoned after a few years. Remnants of the canals can still be found. Farmers would like to see them resurrected, but only if the water is stored for use in dry times.

Estimates of production and cost/benefits

Not only is the system of taro cultivation unique, it is very productive although inputs are low. Estimates of yield were obtained from the G.Dh Gadhdhoo Island Office (Island Office) covering 23 months' collections of 1/8th of the harvest of each farmer. These showed that production from the swamps was about 5 tonne per month.

Two methods were used to estimate yield per unit area. The most direct was to count the number of plants per m² at different parts of the swamp and weigh corms at harvest to obtain an average weight. A common spacing is used throughout the

swamp of about 1 ft (0.3 m) between plants, with 22-23 plants per m². Corms weigh 200-250 g. Therefore, yields are 45-70 t/ha.

A second method took the estimates of harvests from two small plots and related yields to given areas. Yields were in excess of 100 t/ha. Given the inaccuracy of farmers assessing their yields, this is a reasonable check on the first method.

Costs of production were estimated on the second method. After taking into account the title of 1/8th production required by the Island Office, costs of tools (forks, wheelbarrow, bags) and transportation (a rowing boat), returns were estimated to be US\$68,000/ha/year. This does not take account of labour inputs.

Varieties, local and introduced

Aulhurala is the most common taro variety, popular for its taste; next is Bobuala, then Huduala and Raiala. There are differences in height, size of leaves, taste and shelf life. The resistance of the varieties to major diseases such as Taro leaf blight could not be assessed.

Pest and diseases

No insect pests were seen during the mission and those diseases identified were Dasheen mosaic virus, and fungal ghost spots, caused by *Johnstonia* or *Cladosporium* and leaves spots caused by *Colletotrichum*. None of these are of economic importance.

Recommendations

Survey of production methods

The project does not have sufficient knowledge on taro production on Gan to be able to recommend, with confidence, improved methods of cultivation. This limitation is best overcome by conducting a survey of techniques, and ways of doing this are presented in the report. A questionnaire is provided.

Germplasm introductions

Although the varieties grown are adequate for present needs, introductions are suggested to relieve a vulnerability that exists to Taro leaf blight, which is not yet present in the Maldives. The introductions - Cook Islands, Indonesia, Malaysia, the Philippines and Samoa - have been tested for all five known taro viruses and will come as sterile plants in tissue culture. Methods of handling tissue cultures are given.

Post-harvest processing

Processors are concerned about the cost of tins presently used to transport taro chips to Male and other locations; they would like to use plastic bags. This change can be made relatively easily, the size of the bags determined by the potential market outlets. Changing to plastic bags will require processors to purchase sealers, and there will be need for labels. Costs will increase further if cardboard boxes are required to prevent

the chips in the plastic bags from being crushed. Examples of labels from the Pacific will be sent to the project.

Cooking oil is the most expensive item after the cost of taro and the project should investigate if there are cheaper sources, or whether processors could make bulk purchases to reduce costs.

If shelf life of corms needs to be prolonged and storage rots prevented, this is best done by transporting them in polyethylene bags where they will remain physiologically active and keep for up to 4 weeks.

Water control strategy

First, it is necessary for the farmers to have ownership of the flood control system, whatever is devised. They say they want to reuse the water during the drier times, using dams or storage tanks: this needs to be checked. One representative on the Gadhdhoo Partnership did not agree this was the case. The three canals dug previously can be cleared easily, but maintenance is the issue. The Gadhdhoo Partnership said that the Island Development Committee should pay, but is this realistic? Storing the water makes sense and perhaps can be used for raising horticultural crops to recoup some of the costs for maintenance. A study tour for Gan farmers to Foahmuah is recommended to see how people there have solved the problem. These are some of the issues that the water engineer will have to contend with.

Demonstrations with farmers

Although premature to recommend a series of agronomic demonstrations before there is a better understanding of taro cultivation on Gan, nevertheless, it is suggested that the project work with farmers to determine the benefit of using organic amendments. The Island Office should ask farmers to register their interest to take part in the trials: each farmer comparing the effect on corm yields and other growth parameters on one or two varieties from incorporating leaves of *Hibiscus tiliaceus* into the plots before planting, compared to a non-treated control plot. Methods of doing this are explained.

It is recommended that the farmers come together for briefing on the methods to be used and later meet to share their results. The farmers will test the new varieties when they become available.

Demonstrations at the G.Dh Atoll School

The Principal of the school is keen to involve students in the Agriculture Club in taro cultivation so that they learn about this important crop that is part of the culture of the island. Taro cultivation on Gan is a unique example of sustainable production of a staple food crop making maximum use of a difficult environment. It also exemplifies the advantages of biodiversity and (likely) use of organic amendments. Advice on techniques can be sought from experienced farmers leading to comparisons between varieties, organic amendment; and the project can supply tools and cooking utensils to the Club as required. There is plenty of scope for Internet searches to discover the history of taro in agriculture world wide, the chemical composition of the corms and

the leaves, and how both can be used as foods. In order to stimulate interest, the project can offer prizes to the best essays, compilation of experimental results and food preparations. If the recipes are successful they should be “shown” at food fairs and provided to the Parent-Teacher Association for wider interest.

Demonstrations of the use of leaves

The absence of leafy vegetables in the diet of people on Gadhdhoo is very noticeable. Taro leaves are an important source of vitamins (A, B and C), minerals - especially iron - and protein, and should be promoted. Some recipes from the Pacific have been provided to the project, and one tested successfully during the mission. Not only should the leaves be promoted on the island, but also efforts made to interest resorts to use them so increasing potential economic returns from growing the crop. Recipes devised in the Pacific for use in hotels and resorts there will be made available.

1. Introduction

A visit was made to Gadhdhoo, 19-27 July 2008, to evaluate the rain fed, wetland cultivation of taro in Gan, a nearby, uninhabited island. A field assessment was made and farmers met to determine present systems of cultivation, as well as limitations on production and post-harvest handling. Based on these assessments, methods of improving the present systems of taro cultivation were considered, including the need for demonstration areas and practical training.

Prior to the visit, a participatory rural appraisal and forestry resource assessment had identified flooding as a main limitation on taro production on Gan. This being so, it was planned to recruit an engineer to suggest methods of flood control, and for the visit of the engineer to coincide with that of the taro improvement consultant. This did not happen. Recruitment of the engineer was delayed and has prevented practical suggestions being discussed in this report.

Terms of reference of the mission are presented in Annex 1; a daily log, including the people met, Annex 2; a questionnaire for interviewing taro farmers, Annex 3; recipes for taro leaves, Annex 4; and lists of farmers attending a meeting on 21 July, Annex 5.

2. Assessment of taro cultivation

2.1 Brief outline of taro cultivation on Gan

Taro are grown in two shallow, saucer-shaped swamps up to 1 metre deep (Forestry Resource assessment, 2008), divided by bunds into areas that vary from small discrete patches, 5-6 metres diameter to expansive fields of up a quarter of a hectare. These patches and fields are divided further with logs and sticks to demarcate individual ownership. The bunds are frequently planted with bananas and fruit trees. Only small areas are planted at one time to stagger production and provide a continuous supply, because of this the plantings appear as a mosaic of taro of different ages.

The most common planting material is the petiole base plus a small, 2 cm, remains of the corm. Suckers are used, especially when 'tops' are in short supply, but they are not common as the close spacing used mitigates against their formation. Harvests are at approximately 6 months. The plants are pulled from the mud, the corms removed and the tops or suckers with 2-3 leaves attached are replanted, often on the same day; they are simply pressed into the mud at about a third of one metre spacing or 22-23 per m². The old leaves wilt, dry and collapse into the mud, recycling nutrients, and new leaves and roots emerge and with them the start of the next generation of plants.

Synthetic fertilisers are not used, nor are pesticides. Some farmers maintain fertility by adding the leaves of *Hibiscus tiliaceus*; however, this practice is not common, and in discussions only a third of farmers said they did it. It is important to note, however, that all the farmers knew of the technique and realised that it was beneficial, but it was hard work, and that was the reason many did not do it. They preferred to harvest and replant the same day, rather than spending time and effort digging in the *Hibiscus* leaves, even though corm yields were greater if they were used.

Other ways of recycling nutrients that are used occasionally involve spreading corm peelings on top of the plots or leaving the roots removed at harvest to rot in the water at the sides of the fields beneath the bunds. On the other hand, ash seems to be used by all farmers, and is spread over the plots about 2 months after planting when the plants have three leaves, at a rate of 25 kg on a plot of 100 x 50 ft (0.54 t/ha). The ash is collected from burning vegetation collected in the swamp or brought from kitchen fires on Gadhdhoo. It is first mixed with soil taken from under Hibiscus trees. No mulch is used.

Usually, the swamps are cropped continuously without fallow. How long this has been so is not certain, but mostly likely for many generations. Respondents said that they started growing taro as teenagers, inheriting the plots from their parents and, in some cases, leasing them from the Island Office. Individuals may have several large plots and other smaller ones, with a combined area of 5000 ft². There are areas that are not cropped, but these are not under a fallow as such: they are excess to immediate need.

If areas are fallowed – for instance when the owners are too sick to maintain them – and then later cleared of sedge, other weeds and bordering trees, these are allowed to dry and then burnt and the ashes are spread on the newly turned soil. Other than leaves, for some, and ash for all, there are not other inputs apart from labour.

2.2 Overall assessment of the taro cultivation system of Gan

The system that has been developed on Gan, and, presumably on other nearby islands, is remarkable and unique in terms of taro cultivation worldwide. This is not to say that there are no other examples of taro grown in swamps; there are, for example in Cook Islands of Polynesia and Palau in Micronesia, but in these cases the taro are grown in swamps where the water is moving horizontally, albeit slowly. Except for this, taro cultivation in Palau shows many parallels to that on Gan, whereas in Cook Islands the taro are grown on raised beds with broad drains around. Even in these situations, root rots are often common and the land is fallowed after a time, which lowers the incidence of fungi, mostly *Pythium*, that cause the rots, before the land is returned to cultivation once more. In the Maldives, this is not the situation: there is intensive, continuous cultivation, dating back many generations, without the concomitant occurrence of corm and root rots.

It is important to understand this system, which has been devised over many hundreds of years to provide a sustainable source of food, before making suggestions on “improved” cultivation practices, backed by demonstrations, or for the introduction of germplasm. Such recommendations may do nothing to improve the situation. What is needed is a proper study of the taro cultivation system on Gan, so that any recommendations from the study are properly based.

The second important issue is whether or not the taro grown on Gan and on other atolls of the Maldives is vulnerable to pests and diseases that occur elsewhere. Inspection of the taro on Gan suggests that they are extremely vulnerable. Pests and diseases that are commonly present in most other countries that grow taro are absent from Gan. However, none of the people spoken to understood that the introduction of new varieties had associated risks. The Maldives does have a border protection

service, but how well it is equipped to prevent the introduction of pest-ridden plant material or the wherewithal to tackle any new pest incursion should it occur was not verified. But the recent outbreak of the Coconut hispine beetle might suggest that the ability to prevent introductions of pests and diseases is still being developed.

Under the circumstances, a public awareness campaign that stresses the potential risk from the introduction of taro from other countries might be a far better investment of scant resources. There are examples of how one might be done from the Pacific, which confronts similar situations to that of the Maldives.

2.3 Past attempts at water control

2.3.1 Canals and their history

The problem of flooding is not new to Gan, nor is the idea of controlling the flood water. In the 1960s, canals were made by farmers from Gadhdhoo, with help from several other islands - Vadhoo, Faresh and Gemanaffushi, in particular - to drain the flood water into the sea. However, after about 6 or 7 years the system was no longer effective as the canals were not properly maintained, and once again the fields flooded during times of intense rainfall, especially during the northwest monsoon, but also at other times of the year.

It was said that Foahmuah, a nearby atoll, constructed drainage canals in the 1980s and they are still in use. It is not clear who financed the canals, but it is likely that it was the Government, and the people contribute to their upkeep. It is necessary to clarify the situation.

There is much to learn from what has gone before. It is obvious that a simple drainage system can work, but maintenance is a major problem. There is also the need to determine why the canals are successful on some atolls but not others. It appears that those on Gan were dug during a time when the island was in private hands and people expected that their labour would be rewarded by the owner helping with canal maintenance, but this did not happen; disillusionment set in, the farmers did not provide money for the maintenance of the canals and they were abandoned.

The exact turn of events is not altogether clear. But what is clear is that there appears to be no enthusiasm to reuse the canals if it means the water will be wasted. But the situation appears confused: the farmer representative to the Gadhdhoo Partnership felt that there was no need to irrigate the fields in the dry season. And then there was the problem of maintenance of the canals if they are cleared. The Gadhdhoo Partnership thought that the Island Development Committee should take charge of this, but is it reasonable to assume that this is a sustainable solution. The alternative is to leave it to the farmers to organise, but is this likely to be any more successful than before? Many of those who grow taro are old, and they know that maintenance will once more become a major issue. An agreed solution should be found before the flood control system is put in place.

2.3.2 Present thinking and state of the canals

This is not to say that the farmers have abandoned the hope of flood control: they have not. They would like to see a dam built to collect the floodwater so that it can be returned to the fields in times of dry weather. This was the unanimous feeling of the farmers' meeting (21 July); the farmers were not interested in canals alone; they do not want the water to go into the sea. Some farmers at that meeting knew of the canal and gate system on Foahmuah, but did not wish to have such a system on Gan; they simply did not want to waste the water.

It is likely to be very difficult to convince the farmers that they should accept the previous status quo. The idea of a dam is well held by all those who were at the meeting and others met during the mission.

However, the canals or the remains of the canals are still there, and how they might be used, if at all, should be considered. There is one on the eastern side of the island and two on the west. As would be expected after 40 years they have been filled in along most of their length, but in parts they are still more than a metre wide and a similar depth. The canal on the eastern side is about 250 metres from the swamp to the coast. Of the two on the western side, one is also about 250 metres and the second much shorter, only 100 metres.

2.4 Grouping of the fields based on water availability

There appeared to be little difference in the fields throughout the entire swamp, and farmers did not recognise any areas that were more prone to flooding than others or that were more fertile. There may well be differences, perhaps with the central parts flooding to greater depth, but farmers would have difficulty in identifying them, as the chances of making comparisons are not easily made.

2.5 Seasonal calendar

2.5.1 Seasonal differences in production

Farmers were asked if there were differences in the work they did each month in the taro patches, in terms of planting, harvesting, and cultural operations, but they said there were none. They were also asked about harvests and whether there were relative differences in yields depending on the time of the year. Again, there were none.

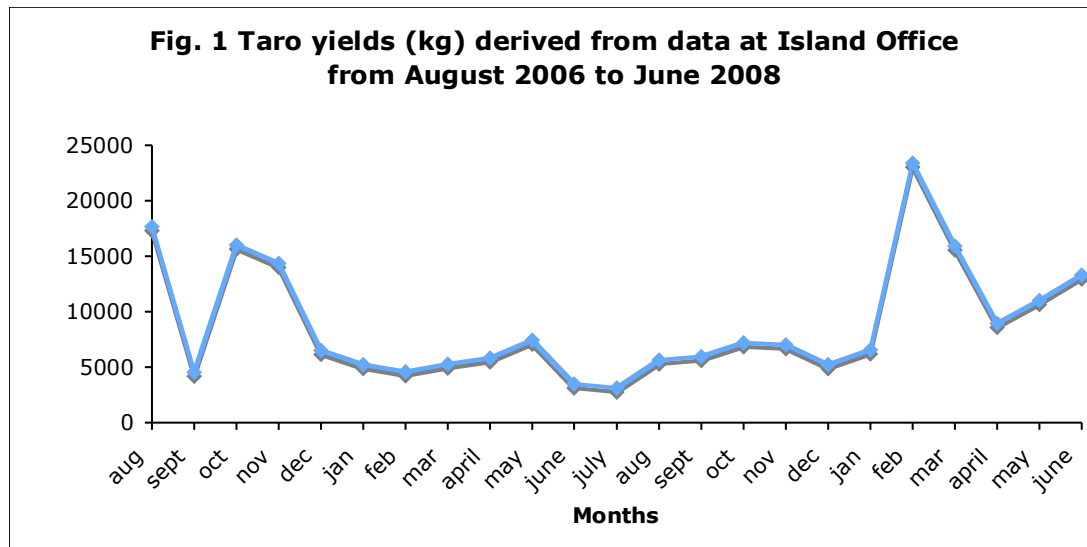
It would appear that there are no seasonal differences in the cultivation of taro on Gan, at least none that the farmers could articulate. Also, there was no evidence presented that the farmers concentrate planting of tops and suckers after the rainy (monsoon) season; they plant at any time of the year, irrespective of the potential loss caused by flooding (see 2.6 below).

2.5.2 Yearly production of taro

Production figures in terms of tonnes per unit area are hard to come by, as the area of the swamp is not known with any accuracy. As the Forestry Resource Assessment of Gan (2008) report states (page 17):

Accurate data on total number of taro farmers and area under its cultivation has neither been provided by the Island Office nor by the IDC. However, the senior citizen farmers stated that there are about 150 farmers engaged in this work. The average size of the farm being about 400 – 1600 m², the total area under Taro cultivation comes to about 640,000 – 240,000 m² i.e., 6 - 24 ha.

This is a large range and of little use in estimating yields per unit area. Fortunately, the Island Office has accurate data on output as it collects a tithes of 1/8 of farmers' harvests¹, much of which is sold to local processors. Unfortunately, the Island Office only took over the collection of data relatively recently and its records begin in August 2006. Data previous to that is said to be in Male. Nevertheless, the data, spanning almost 2 years show that production averages about 5 tonnes per month, although there are unexplained peaks in both 2006 and 2008. There is obvious need to further chart the data to see if this figure is substantiated.



How much of the production is used for home consumption, processed as chips and other foods or exported to other islands is not known exactly, but it is thought that as much as 80 per cent is processed or exported². Data are not maintained.

2.6 Problems of taro cultivation, including flooding/lack of water

Discussions with farmers either individually or in groups suggested that the main problems were pests and diseases or those associated with flooding. A whitefly was said to be serious at certain times of the year, but it was not apparent at the time of the visit.

The most important problem is flooding during periods of intensive rain. This comes mostly during the northwest monsoon, June, July and August, but it is possible at

¹ Although horticultural land is charged at a rent of 0.02 laari per ft², this is not so for the taro land where an eighth of all harvests is collected and sold by the Island Office.

² It is possible that home consumption may increase with escalating prices of rice and flour on world markets.

other times of the year. It may take 10 days or more before the floodwaters recede and during that time recently replanted taro and those up to 2-months old are destroyed, and the leaves and corms of mature plants start to rot. Farmers said that this happens up to four times a year, and can cause considerable damage, although this was thought to be exceptional. There was nothing the farmers could do to ameliorate the damage, as it was impossible to drain the water during these times.

Last December, for instance, there was heavy rain and flooding and it was 10 days before the situation reverted to normal. December 2006 was another period of intense rain when it was reported by Island Office staff that there was almost 1 metre of water above the taro, beginning 15 December and continuing for several days thereafter. Even by the 26 December rough seas were reported, and the situation in the taro fields had not returned to normal.

At the time of the visit, there was an intensive period of rain on 21 July and the fields had some 10 cm of water in the following days. Some of the farmers interviewed said that the newly planted taro would die, and there were patches that were submerged, but these were rare. However, whether the farmers meant that the outer leaves would die, not the entire plants, was not clear. The only way to be sure is to monitor some of the plots, and the NPM will keep the fields of Mr Idris Ali and Mrs Naeema Zahir under observation.

2.7 Post-harvest handling, including processing

After harvest, the corms are scraped to remove the roots, the petiole tops removed to be replanted and the bottom part cut to remove the residual planting piece. They are then placed in rice or cement bags and taken to Gadhdhoo for sending to Male or other centres or processed into chips and other foods.

2.7.1 Chips

Chip making is a popular pastime, with sales in Male and also in Thinadhoo, the capital of the Gaafu Dhaallu Atoll, that includes Gadhdhoo. It is said that prices in Thinadhoo are higher as most people send to Male.

If the chips are sold for Rf150 per tin and each 50 kg taro corms yields the equivalent of five tins then the profit is Rf360 or thereabouts, which shows a relatively small return to growers who grow their own taro. If a processor had to spend a further Rf250 to purchase the corms, the profit would be Rf110 on an outlay of Rf250 for 50 kg corms. Apart from the cost of the corms, oil is a major cost.

Activity/Item	Cost (Rufiyaa)	Quantity	Cost per 50 kg taro (Rufiyaa)
Taro	250	50 kg	250
Cooking oil	450	20 litres	225
Peeler	45	1	?
Small knife	25	1	?
Firewood			?
Slicer	400	1	?
Empty tins	15	5	75
Freight	6	3	18

Pick up charge	40	Per 5 tins	40
Total			608

The reason for the popularity of processing taro, albeit for a small profit, is likely to be because people do not cost their own labour; neither do they factor in the cost of firewood, which has to be obtained from nearby uninhabited islands where it is said to be plentiful. If these were added to the costs, processing would be marginal at best on the small amounts produced. No doubt these additional costs, and the cost of corms, would be taken in account when the project determines the feasibility of a taro processing plant. Under the circumstances, leaving processing of chips to a cottage industry might be the best solution, with some improvements to present practices.

Quantifying the advantages and disadvantages of processing taro over sales of fresh corms, more than has been done above, is not possible at this time. A thorough study is needed on the products, their quality and the potential markets in the Maldives. However, the obvious advantage of processing taro corms into chips, and *dhai* (see below) is, apart from value adding, the increase in storage life. Corms lose water rapidly and perish due to fungal infections after a few days, whereas chips can be kept in tins or plastic bags for weeks, if not months. If packaged properly, storage pests are unlikely to spoil them.

It is worth noting that placing corms, unscrapped, in plastic bags where they remain physiologically active, can extend their shelf life. In this condition, storage can be extended up to 4 weeks.

2.7.2 *Dhai*

Another product made from taro corms is *dhai* (literally meaning “teeth”) – slivers of corm with added spices – selling for Rf5 for a packet of 100g. The slivers are coated in a paste made from chilli powder, cumin, ginger, onion and garlic, and then fried in oil. Like taro chips, they make a tasty snack, but in this case more so because of their spicy flavour. *Dhai* is sold in plastic bags with a plastic draw tie.

2.7.3 *Leaves*

Taro leaves are not eaten as a vegetable in the Maldives in contrast to most places in the world where the crop flourishes. This is surprising, but it is not so much a matter of choice: people do not realise that they are edible. Suggestions that they are a nutritious food often brought about incredulous laughter. In fact, taro cultivation is one of the reasons for the relatively good health of Pacific peoples traditionally – the taro corm and leaf together providing almost all the nutrients required. The stalks also can be used, if properly prepared.

The leaves are an especially rich source of vitamins and minerals: They are a good source of thiamin, riboflavin, iron, phosphorus, and zinc, and a very good source of vitamin B6, vitamin C, niacin, potassium, copper, and manganese. Vitamin A is needed for proper growth, healthy eyes and for the functioning of the immune system to ward off disease; vitamin C, helps the body use iron and promotes other chemical actions; vitamin B1 (thiamin) helps the body use energy foods; and vitamin B2 (riboflavin) is needed for normal growth and healthy eyes. In addition, the leaves contain useful amounts of calcium, and have a protein content of about 20 per cent on a dry weight basis.

There are many recipes used in Pacific Island countries for the preparation of taro leaves and others for stalks. The leaves can make the mouth itch, if they are not prepared and cooked properly. The usual method of cooking involves boiling (blanching) first in water, then the water is drained and leaves are reboiled in a small amount of water or coconut cream. Other methods involve cooking in coconut milk with subsequent additions of coconut cream, or more involved cupping the leaves, adding coconut cream, wrapping in banana leaves and cooking in an earth oven or steaming. Onion is often added as well as chilli and lemon juice and/or chopped pieces of meat or fish. These are tasty and nutritious dishes! Several recipes were left with the project so that it can experiment before passing the information to farmers. During the mission *rourou* (Annex 4) was made and it was well liked.

2.8 Cost and benefit analysis of taro cultivation

It proved difficult to get reliable statistics on production that could be verified. However, the data provided by Mrs Mariyam Zubaira and her husband was thought to be reliable. She and her husband have two large plots that are 50 x 80 ft (15.2 x 24.4 metres) and 40 x 60 ft (12.2 x 18.3 metres); they have recently yielded 100 kg per day for 4 months, and 100kg per day for 2 months, respectively. Note, harvests are taken on 3 days a week, i.e., 48 and 24 days respectively.

These figures equate to yields of 130t/ha and 108t/ha for the two plots. If they are correct, yields of taro on Gan are some of the highest in the world, if not the highest. However, leaves were added to the soil and this may account for the success of the farmers in this case. It will be worth testing the effect of adding leaves (mostly *Hibiscus tiliaceus*) as a compost.

Costs of production are listed in the table below. It can be seen that they are low, but for the tithe taken by the Island Office in lieu of rent for the land. The second largest is sacks, and the third, the cost of the rowing boat to get to the island on three days a week³. The Island Office takes 1/8 of the harvest and this has been calculated in the example at 900 kg, which is sold by the Island Office for Rf5/kg or Rf4,500 in total.

Item	Cost (Rufiyaa) /item	Items per farm	Cost/farm (Rufiyaa)	Life period		Cost per crop (Rufiyaa)
				Year	No. crops	
Large knife	200	3	600	3	6	100

³ Note farmers are only allowed to visit Gan three days a week, on Tuesday, Thursday and Saturday, by order of the Island Office and IDC.

Fork	120	2	240	3	6	40
Wheelbarrow	650	2	1300	5	15	90
Bags	10	72	720	0.5	1	720
Rowing boat	35,000	3/7	15000	20	40	375
IDC tithe	4500					4500
Total						5825

If the remainder of the harvest (6300 kg) were sold at Rf5/kg this would bring in Rf31,500 (US\$2,470). Minus costs, the return is Rf25675 (UD\$2013). These returns are from only 594 m² in 6 months. If accurate, they are a creditable achievement; they are equivalent to US\$68,000/ha/year.

A way of checking these yields is to consider the average number of plants per square metre in the swamp, and this was done in several places. The number of plants on average was 22-23. The weights of corms without roots and tops were estimated to vary from 200 to 300 g. Thus, yields are approximately 4.5-7 kg/m², or 45 to 70 t/ha. This is considerably less than the estimates given by Mrs Mariyam Zubaira above, but they are still very high for taro or for any other root crop. In this case, the returns would be approximately half those given above.

In general, there is no hired labour working in the taro plots. However, a few (three to four) families do employ labourers from Bangladesh, paying US\$200/month, which covers salary, food, accommodation and Government fees. This is unusual and has not been included in the costings presented above, still making taro production a profitable business.

3. Varieties grown and potential of new introductions

3.1 Local varieties

There are four varieties presently grown on Gan. Characteristics of these are as follows:

Characteristics	Varieties			
	Aulhurala	Bobuala	Raiala	Huduala
Leaf/plant size		Large	Tall	Large
Skin colour	White	White	Red	Yellow
Skin thickness		Thick		
Flesh	White	White	White	White
Taste	Excellent	Good	Good	Good
Time to maturity	6 months	8 months	6/7 months	7 months
Growth rate	Slow	Slow	Fast	Fast
Corm shape	Cylindrical	Cylindrical	Cylindrical	Cylindrical
Storage	Good (7-10 days)	Good	Poor (3-4 days)	Moderate
Acridity			More than others	
Other				Cooks quickly

Aulhurala is the most popular and common taro, followed by Boduala, with Huduala third. However, all four are acceptable as table taro and for processing into taro chips. The first two (Aulhurala and Boduala) are said to store better than the others and, therefore, are best if the taro are transported to Male or elsewhere. In general, these two varieties mature in 6 months and rots occur only if harvests are delayed till 8-12 months. The weights of individual corms vary from about 200 to 300 g.

3.2 Introductions from the Pacific and Asia

The lab at the Centre of Pacific Crops and Trees (CEPaCT), within the Secretariat of the Pacific community, Fiji, has put together a small collection of taro based on evaluations in Pacific Island countries.

Some of these were grown in Wallis and Futuna under wetland conditions and found to perform well. In addition, most have resistance to taro leaf blight caused by the fungus, *Phytophthora colocasiae*. The Maldives is vulnerable to this disease, which elsewhere has decimated taro production.

Variety code (CePACT)	Country of origin	Name	No of tubes	No of plants	Comments
BL/SM/10	Samoa	Breeders' line	3	3	Resistant to taro leaf blight; very good eating quality
BL/SM/26	Samoa	Breeders' line	2	3	Resistant to taro leaf blight; very good eating quality
BL/SM/46	Samoa	Breeders' line	3	7	Resistant to taro leaf blight; very good eating quality
TAN/MAL/12	Malaysia	Cultivar	4	6	Resistant to taro leaf blight; very good eating quality
TAN/MAL/14	Malaysia	Cultivar	1	1	Resistant to taro leaf blight; moderate eating quality
TAN/IND/12	Indonesia	Cultivar	4	5	Susceptible to taro leaf blight; good eating quality
TAN/THL/09	Thailand	Cultivar	4	6	Susceptible to taro leaf blight; acceptable eating quality
TAN/PHL/14	Philippines	Cultivar	1	1	Tolerant to taro leaf blight; good eating quality
TR/CK/07	Cook Islands	Purenga	4	4	No information, but probably susceptible to taro leaf blight

The taro accessions have tested negatively for five viruses, namely Taro bacilliform virus (TaBV), Dasheen mosaic virus (DsMV), Taro reovirus (TaRV), Colocasia bobone disease virus (CBDV) and Taro vein chlorosis virus (TaVCV). The plants were grown from meristems and then tested for each of the five viruses using the highly sensitive polymerase chain reaction (PCR), with both negative and positive controls. Each accession was tested for viruses at least two times, usually at 3 and 6 months.

4. Pest and diseases

4.1 Overall assessment

Pests and diseases at the time of the visit were inconsequential. This is quite a remarkable situation as one grower said that he had been cultivating taro in the swamp since he was 12 and he is now 58, and his parents and his grandparents had done the same. There were mention of rots, but this seemed to be occasional only and thus not a serious problem overall.

A white fly was said to occur, but as it was not present at the time of the visit, it was not identified. It is most likely the spiralling white, which can be seen on Gadhdhoo, on cassava, in particular. When outbreaks of this pest were first seen on taro, when it was first introduced, they would have been severe, and farmers may be remembering these occurrences. The history of introduction to the Maldives is not known, nor whether the *Encarsia* wasp, a biological control, accompanied the introduction. Whatever the situation, the whitefly is now well controlled, but it is possible for occasional imbalance between host and parasitoid to occur, when again levels of whitefly increase. However, these will always be quickly brought under control.

4.2 Pests and diseases recorded at the time of the visit

There were few signs of pests and diseases during the visit, in fact, insect pests were absent, and only a few diseases seen, but none were serious. It was notably that the Taro planthopper, *Tarophagus* spp. is absent. As with Taro leaf blight, it is extremely important that this insect is not introduced, otherwise the plants will be severely affected; large numbers of the planthoppers cause the plants to wilt.

4.2.1 Ghost spots on older leaves

These occur occasionally as light brown to orange spots or indistinct blotches on the top of the leaf and more discrete spots on the underside. They are called ghost spots, as the fungus does not penetrate to both sides of the leaf; spots and blotches on one side being confined to that surface alone. The cause is either *Johnstonia colocasiae* or *Cladosporium colocasiae*; it is not possible to determine which without looking at the spores under a microscope. This is a common fungus wherever taro is grown and is of no economic consequence whatsoever and, therefore, no control measures are needed.

4.2.2 Dasheen mosaic potyvirus

This virus has a worldwide distribution and so it is not surprising to see it on plants on Gan. Remarkably, the incidence is very low, with only a few plants seen with symptoms from the many thousands inspected. Plants can have latent or hidden infection when the virus is present but symptoms are not expressed. Aphids, which were not seen on the leaves during the visit, spread it and their low numbers may be the reason why incidence of the disease is so low.

4.2.3 Colletotrichum leaf spots

Minute leaf spots, 1-2 mm diameter, are common on leaves of plants growing in shade beneath trees at the side of the plots; they are absent where plants are growing in the full sun. Like Ghost spot, this is a common fungus on taro, and as far as it is known has no appreciable effect on yield. No control measures are necessary.

5. Recommendations

This section summarises the recommendations made throughout the report.

5.1 Improved cultivation methods and post-harvest handling

Before the project carries out demonstrations and training, it is strongly recommended that it study the production system for taro cultivation on Gan. Knowledge on taro production within the project is not of a level that can provide technology development or training that will satisfy the needs of farmers.

Further, it is recommended that the training programme mooted in the project plan be held in abeyance until the results of the survey and farmer experiments are obtained. There is very little useful information that can be provided to the farmers at this point in time.

5.1.1 Taro survey of production methods

A simple survey form is provided in Annex 3 to be used to collect information on the Gan production system. This will provide the information on techniques and importantly on yields that cannot accurately be obtained during a short visit. This questionnaire should be completed for, say, 15 farmers, selected at random from the list held by the Island Office, or the Island Office ask for volunteers to participate in the survey. It is important that those selected should include some whose expertise is recognised by the community. The NPM should collect the information.

The information collected will provide data on production techniques, yield, and post-harvest uses and will be useful for planning. It will be relatively easy to collect this information and to report on the results.

5.1.2 Taro introductions

It is recommended that the Maldives introduce nine varieties (3.2) and distribute them to growers, telling them of their importance. The taro are available as pathogen-tested tissue cultures. To obtain these, a request will be necessary from the Ministry of Fisheries, Agriculture and Marine Resources to the CePACT, Fiji, which will send a Material Transfer Agreement for signature by a Government representative.

The nine varieties that have been selected will be sent as pathogen-indexed tissue cultures. These are to be treated as follows:

1. Carefully, take the plants out of the tubes; ease them out rather than shaking them
2. Wash the roots carefully free of agar
3. Plant in a peat pot (Jiffy) or equivalent small pot, and water well
4. LABEL each plant
5. Either place a plastic bag over each plants OR make a frame covered with polythene and put this over several (or all) the pots
6. After about 3 days or when new leaves are starting to develop, reduce the humidity inside the plastic bag or box by: a) making holes in the plastic bag; or b) taking the box off the plants for increasing periods during the day.

7. When the plants are hardened, and when they have reached the 3-4 leaf stage, repot to larger containers
8. Note that if the plants are watered with Thrive or Aquasol or another complete soluble fertilizer, growth will be much faster
9. When they reach 20-30 cm, transfer to the swamp for bulking. Only do this when knowledge indicates that the plants have reached a stage when they will survive planting in the swamp
10. Plant the varieties at 60 cm spacing so that they produce suckers. If plated at normal spacing they will not produce suckers and multiplication will be very slow.

Once there is sufficient planting material, then the taro should be given to lead farmers to evaluate, following their normal practices. At harvest, and at other times during the growth of the plants, the farmers should come together to discuss the advantages and disadvantages of the introductions. However, it is important that they be reminded that the plants have been chosen for their resistance to Taro leaf blight, and even if they are not preferred to their traditional varieties, they should retain some plants of each in their farms against the future spread of the disease to the Maldives.

5.1.3 Post-harvest processing

As indicated above it is difficult to obtain figures for the amount of taro that is sold fresh compared to that which is processed into chips. But it is thought that about 80 per cent are processed. Chip making is well established on Gadhdhoo and the product is well made and popular. The only complaint is the cost of tins, and people wish to change to plastic bags, carrying a label identifying the place of manufacture. Examples of labels used in the South Pacific will be sent as examples.

Changing the method of packaging may be cheaper, but putting the chips in plastic bags means they are more liable to breakage. To prevent this, the chips may need to be shipped in cardboard boxes and this will add to their cost of manufacture. The project will need to monitor this carefully.

There is also an opportunity for the project to advise processors on how to reduce the cost of cooking oil, which is the main ingredient in processing and second only to the cost of the corms. The high cost of oil, which is likely to increase further, is a concern and the project should investigate cheaper sources or how processors could take advantage of bulk purchases. After the cost of taro, it is the single most expensive item.

Apart from adding value and increasing storage life of taro, processing also has the advantage of increasing the sales to the tourist resorts, where the products will find a ready market. Fresh taro could also be marketed to these outlets, but from experience in the Pacific, there seems a reluctance of hotels and resorts to use taro as main carbohydrate, perhaps because of its unfamiliar taste to guests or because the establishments are concerned about obtaining regular supplies. Either way, there are numerous recipes devised specially for resorts that might be of interest to the Maldives, and these can be supplied.

To do the awareness properly as well as find new outlets for chips in the hotels and resorts, the project will need to appoint an agent in Male. If successful, these establishments will indicate how best to package the chips to attract sales.

The fresh corms storage sufficiently well to transfer to Male and to other locations, although one variety, Raiala, was said to keep for only a few days before rots set in. If storage life needs to be extended this can be done easily: use plastic bags. The corms should be harvested, the petioles and roots removed – doing as little damage as possible – and placed in thick plastic (polyethylene) bags. Kept this way, shelf life will be extended considerably, by as much as a month.

5.2 Water control strategy

There is obviously a need for a qualified water engineer to look at the canal system that was imposed previously to control the flooding of the taro fields, and to suggest if there is any alternative method that will satisfy the wishes of the farmers.

The canals that were dug before appear to have controlled the flooding: none of the many farmers interviewed suggested that the canals had not work as intended. The argument with the system is that the floodwater is wasted: the farmers would like to use the water during dryer times of the year. That is understandable.

Digging out the canals, perhaps using a backhoe attached to the tractor that has recently been donated to the Island Office (if it is powerful enough) and constructing a dam or perhaps installing a series of plastic water storage tanks would meet the people's expectations. Such a system would need a pump and water pipes to transfer the water back to the fields during dry times. It is possible to achieve, but at what price needs to be determined. It is also important to determine if people are willing to help maintain a new system. If this work were done, would the community assume ownership of the flood control system to ensure its sustainability? If not, then there is no point in doing it: it will always fall to the Government to maintain or be abandoned as it was previously.

A study tour for farmers to see the flood control scheme operating in Foahmuah is recommended. Upon return, a meeting should be held with the community to explain the situation. The NPM should accompany the growers and photograph the system in operation there. The visit should take place before the visit of the water engineer.

Such a system for water retention using dams and storage tanks on Gan might be attractive for another reason: it could provide water to vegetable growers nearby and by so doing defray some of the costs of maintaining the canals, dam or water storage tanks.

5.3 Plan for demonstration site for taro cultivation

5.3.1 Demonstrations with farmers

It is premature to recommend demonstrations prior to an in depth understanding of present production techniques (see 5.1.1). The system of cultivation used on Gan and other atolls has been developed over hundreds of years and the sustainability of high

yields testifies to its sophistication. It would be presumptuous of anyone to assume that it could be improved without a thorough study and understanding of its components.

However, there are sufficient differences in techniques to suggest that it would be beneficial to make some comparisons. The most obvious difference between growers is the use of organic amendments. The question is, does the incorporation of leaves of *H. tiliaceus* make any difference to the growth of taro and to yield? If so, how large is the difference?

To answer this, the project should request the cooperation of lead farmers who are willing to experiment – participatory technology development - and willing to share the information obtained from the experiments with other farmers. The project should aim to have at least five farmers taking part in the experiments, preferably more.

The following criteria should apply:

- Farmers should be requested to register their interest to take part in the demonstrations at the Island Office (a suggestion by the Gadhdhoo Partnership)
- Those chosen should be recognised as being experts in taro cultivation
- The sites selected should be scattered throughout the swamp
- The area of the experiential plots should be at least 15 m²
- The experimental plots of each farmer should be the same, but they can differ between growers - let the farmers choose the size convenient to them
- For each farmer, decide if the comparisons will be made between one or two varieties – suggest Aulhuala and Boduala
- If one variety, then a farmer will have two plots; if two varieties, four plots
- The lead farmers should be able to make notes or have family members who can do it for them.

Farmers would choose two areas, each 15m², one of which will have the addition of Hibiscus leaves before planting and the other without – the farmers should meet beforehand and agree to how the leaves are added to the mud and the approximate amounts. If the plots can have two border rows around them, this would be an advantage. All other cultural practices would be the same in the two plots. Farmers would be asked to record information and take observations as indicated below:

- Variety or varieties
- Size of plots (feet or metres)
- Length of time to put the Hibiscus leaves in the plot(s)
- Date of planting
- Type of planting material, suckers or tops
- No. of plants in each plot
- Average number of leaves per plant
- Colour of the taro leaves at monthly intervals
- Approximate height of the plants in the two plots and size of leaves
- Harvest yield: weight of corms from each plant (project would weigh corms at harvest)
- Any other issues of interest

The farmers would come together at the end of the experiments to present their data. The meeting can involve other farmers so that the information is provided to the community.

5.3.2 Demonstrations at the G,Dh Atoll school

Mr Frederick Sam, Principal G,Dh Atoll School is extremely enthusiastic to involve the children in a study of taro cultivation. It fits very well as a subject for the Agriculture Club, which focuses on “green” issues and the environment. The Club has a board composed of staff members and student representatives. The agriculture teacher and the assistant lead activities, and all students are members.

The cultivation of taro lends itself to a study by the Agriculture Club for a number of reasons: there are several varieties used by farmers, underlying the wisdom of genetic diversity; it is an excellent example of using a difficult environment to produce food – only taro and perhaps rice of all the crops used as sources of carbohydrate could be grown in such an environment and the physiology of these crops is interesting; inputs are minimal, but production is high and sustainable; and there are few factors limiting production, except for flooding in this closed system.

The project should support the Club to obtain land on Gan to grow taro, starting out with a small area of a few square metres. Senior students should be involved, and the number limited as the initial plots will be small.

Before beginning the enterprise, experienced taro producers should be asked to guide the students with practical demonstrations in their plots. Afterwards, planting material of the different varieties should be obtained and the plots established. If enthusiasm is high, the students can test the use of organic amendments, putting Hibiscus in some plots, leaving others of the same variety without.

The students should study the growth of taro of the different varieties, recording information as set out in 5.3.1.

During the growth phase, recipes for the leaves can be tested and evaluated (Annex 4). Cooked leaves can also be presented at food fairs; the Principal said that there is three or four a year. And if the recipes are a success, they should be given to the Parent-Teacher Association so that the community can test them.

At harvest, the students should learn how to process the corms into chips and *dhai* but also into other products, the recipes of which they will find from a search of the Internet.

The project may want to consider giving prizes to the best essay on the student study when the results are written up. It may also wish to support the Agriculture Club with donations of pots, pans, cutlery, a gas cooker and other kitchen utensils, purchases of planting material of four varieties, plus help with transportation to Gan. Support provided in this form will not conflict with the school’s method of financial control.

5.4 Improvement of human nutrition

It is very noticeable that leafy greens are absent from the diets of residents of Gadhdhoo. One of the best ways of introducing the concept of eating leafy greens and taro leaves in particular is through schools. The principal of the G.Dh Atoll School was keen to play a part in creating an awareness to promote these nutritious foods.

The use of taro leaves locally on Gadhdhoo and as sales to hotels and resorts could do much for the health of the people as well as providing monetary gain, and the project should investigate their potential. They are perishable, but when cleaned, stacked and placed in plastic bags they remain fresh for a few days. Leaves are exported from Pacific Island countries to Australia without difficulty.

Acknowledgements

I would like to thank Chief Ismail Shameem and Assistant Chief Abdulla Imadha of the Island Office for discussions and for arranging meeting with farmers during the mission. Mr Aboobakuru Mohamed, National Project Manager, gave unstinting assistance during the entire time I was on Gaddhdhoo and accompanied me to Gan. My thanks, too, to Mr Hiroshi Kodama, Expert and Mr Shingo Shibata, Chief Technical Adviser, GCP/RAS/218/JPN (RAFFTA) for arrangements.

I wish to give special thanks to all the farmers met during my visit to Gadhdhoo who willingly shared their knowledge of taro production.

Terms of Reference

Taro Cultivation Improvement Consultant

“Regional Programme for Participatory and Integrated Agriculture, Forestry and Fisheries Development for Long-term Rehabilitation and Development in Tsunami-affected Areas (GCP/RAS/218/JPN)”

Background

In Gan, South Huvadho Atoll, the Maldives, taro with a cylindrical central corm has been extensively cultivated in the wetland. Farmers have cultivated the local variety with indigenous cultivation method. Because of rain fed cultivation method, it is difficult to control adequate water level. Currently needs for appropriate cultivation methods, improved varieties, irrigation system, post-harvest techniques, and marketing have been recognized.

In response to above situations, the project proposes to assist in assessing current situation of taro cultivation and post-harvesting method and establishing a demonstration site to conduct trainings on improved taro cultivation as well as to develop a suitable drainage system.

In order to conduct above-mentioned activities, a qualified expert will be recruited for a short term.

Specification of the work

Under the overall supervision of the Coordinator, RAPR, the FAO Representative in Sri Lanka, the CTA/technical support officers in Bangkok and the direct guidance of the National Project Manager (NPM) for GCP/RAS/218/JPN, and in consultation with island office and farmers in Gadhdhoo, the consultant shall:

- Assess current situation of taro cultivation and post-harvesting method including
 - possible grouping of taro fields based on difference of water availability;
 - cultivation methods;
 - seasonal calendar;
 - problems and obstacles for taro cultivation, including flooding and the lack of water;
 - post-harvesting method including processing and transportation of taro; and
 - cost and benefit analysis of taro cultivation;
- Identify (estimate or find the main features of) varieties locally cultivated and recommend suitable variety (including possible introduction of new varieties) to each group of the fields identified above;
- Diagnose the pests, if any, estimate the loss of the yield or quality, and recommend suitable control methods;
- Provide recommendations on the improved cultivation methods and post-harvest handling;

- Recommend suitable water control strategy which mitigate the problems of flooding and the lack of water, discuss the feasibility of the strategy with the short-term consultant for taro field water control, and assist this consultant in developing the water control plan;
- Prepare a plan for a demonstration on taro cultivation, including proposed site, necessary materials and tools with cost estimates, and detailed work schedule;
- Prepare a practical training plan on taro cultivation and post-harvest handling; and
- Carry out any other related duties as required by the CTA

Reporting and Deliverables:

1. An assessment report including recommendations on cultivation methods, suitable post-harvest handling strategy, pest control system, taro varieties and water control methods;
2. A plan for a demonstration site, including proposed location, list of necessary materials and tools with cost estimates, and detailed work schedule;
3. Training plan on taro cultivation and post-harvest handling; and
4. Day-by-day listing of activities and persons met

Qualifications/Experience: The consultant should have the following qualifications:

- University degree in agriculture and or relevant discipline
- Minimum of 3 years of relevant work experience in taro
- Ability to write clearly and concisely in English.
- Working knowledge of Maldivian language is an advantage

Location: Gan for field work and Gadhdhoo for briefing/debriefing and report writing

Duration: 11 days (including report writing, briefing/debriefing and travels)

Working day allocation of the national consultant (tentative)

Day	Activities	Stay
1	Trip to Male	Male
2	Trip to Gadhdhoo	Gadhdhoo
3	Meet the NPM for briefing and conduct a field assessment	Gadhdhoo
4	Continue assessments, meet the survey engineer and propose possible water control strategy to the consultant	Gadhdhoo
5	Continue assessment and check the water control system developed by the survey engineer	Gadhdhoo
6	Check the availability and prices of necessary materials and develop draft recommendations and a plan for the demonstration site	Gadhdhoo
7	Meeting with taro farmers and, based on the assessment, propose/discuss possible improvements of cultivation, demonstration plan, post-harvest handling and transportation	Gadhdhoo
8	Conduct report writing with feedbacks from farmers as necessary	Gadhdhoo
9	Conduct de-briefing the NPM and submit three draft reports	Gadhdhoo
10	Trip to Male	Male
11	Trip to the home station	Home Station

Daily log of activities and people met

Date	Activities
18 July pm	<ul style="list-style-type: none"> ○ Arrived Male 2200; met by Mr Imran and transferred to Central Hotel
19 July am	<ul style="list-style-type: none"> ○ By plane to Kadhedhoo, and then by speed launch to Gadhdhoo. Arrived at 10 am and met by Mr Aboobakuru
19 July pm	<ul style="list-style-type: none"> ○ On Gadhdhoo, briefly met Island chiefs: Mr Ismail Shameem and Mr Abdulla Imadha (Assistance Chief) ○ By ferry to Gan to meet with farmers and inspect taro fields with Mr Aboobakuru and Mr Abdullah Ahmeem
20 July am	<ul style="list-style-type: none"> ○ Meeting with Island Chief Mr Ismail Shameem and Mr Ibrahim Fuzool, Secretary. ○ Processing of taro into chips with Mrs Mariyam Zubaira and family – relatives of Mr Abdullah Ahmeem
20 July pm	<ul style="list-style-type: none"> ○ Processing of taro into chips and <i>dhai</i> with Mrs Fathumath Abdulla and family
21 July am	<ul style="list-style-type: none"> ○ At the Island Office with the NPM and Assistant Chief, Mr Abdulla Imadha collecting production data
21 July pm	<ul style="list-style-type: none"> ○ Meeting with taro farmers (16) chaired by Mr Ismail Shameem ○ Processing of taro into <i>dhai</i> at residence of Mrs Fathumath Abdulla and family
22 July am	<ul style="list-style-type: none"> ○ Sea too rough to visit Gan. Discussions with Mr Abdulla Mushusim and Mrs Mariyam Zubaira and family on agronomic issues and the costs of production respectively
22 July pm	<ul style="list-style-type: none"> ○ Note writing
23 July am & pm	<ul style="list-style-type: none"> ○ To Gan to investigate water control system used previously and to check fields for pests and diseases
24 July am	<ul style="list-style-type: none"> ○ Meeting with Principal G.Dh Atoll School, Mr Frederick Sam
24 July am/ pm	<ul style="list-style-type: none"> ○ To Gan for discussions with farmers on agronomic techniques, pests and diseases and water control strategies in the field
25 July am	<ul style="list-style-type: none"> ○ Report writing
25 July pm	<ul style="list-style-type: none"> ○ Gadhdhoo Partnership meeting
26 July am	<ul style="list-style-type: none"> ○ Visit to hospital to see family health workers and discuss community health matters ○ Discussions with NPM on the report
27 July am	<ul style="list-style-type: none"> ○ Return to Kadhedhoo and Male ○ Male to Singapore and then to Sydney
28 July pm	<ul style="list-style-type: none"> ○ Arrive Sydney

Questionnaire

Taro production and post-harvest techniques

Name of Farmer: _____

Location of the plots: _____

No. of plots: _____ Area (ft²): 1) _____
 2) _____
 3) _____

Date planted: _____

Variety or varieties: _____

Leaves added to the plots? Yes No (Circle)

What type of leaves: _____

Approximately how much & how added? _____

Planting material: Tops Suckers (Circle)

Spacing of planting material or no. of plants per m²: _____

Observations:

Item	Months					
	1	2	3	4	5	6
Weeding						
Floods						
Whitefly						
Rots						
Other						

Date of harvest: _____

Weight of corms (kg): _____ Average wt (g): _____

Yield (t/ha): _____

Per cent sold as corms: _____ Per cent processed: _____

What did the farmer do with the leaves from the harvest?; _____

Recipes using taro leaves

***Rourou* Taro Leaves in Coconut Milk [Fiji]**

Ingredients

- 6 cups diluted coconut milk
- 1 small piece onion, sliced thinly
- 2 small red chillies
- 17 pieces fresh taro leaves, sliced
- 1 cup coconut cream
- salt to taste

Directions

1. Put diluted coconut milk into a cooking pot and add onion and chillies.
2. Stir constantly to prevent curdling.
3. When boiling, add *rourou* in the mixture and stir occasionally so the leaves are covered with coconut milk.
4. Cook for a few minutes until the coconut milk is almost dry.
5. Then stir in coconut cream and cook for a few minutes. Add salt to suit taste.
6. Tinned fish or tinned beef can be added for a more substantial meal.

***Palusami* Taro Leaves in Coconut Milk [Samoa]**

10-15 parcels

Ingredients

6 coconuts
2 bundles taro leaves - about 60 leaves
2 onions, chopped
2 red chillies
salt

Directions

1. Grate the coconuts, then squeeze out the coconut cream with a fine cheese cloth or muslin. Mix onions, chillies and salt with coconut cream.
2. Take 4 - 6 clean, washed taro leaves and shape them into a cup. Into the centre, put one cup coconut cream, making sure there's some chopped onion.
3. Fold the leaves in carefully, without spilling the coconut cream. Then wrap the bundle in a piece of softened banana leaf or aluminium foil and secure firmly.
4. When all parcels are ready, cook them in an oven or steam for ½ hour.
5. Chopped pieces of meat or fish may be added before the coconut cream is out in the parcel. If this is done, double the cooking time.

Taro Leaf Spirals [India]

Ingredients

- 10-12 taro leaves
- For the spice paste:
 - 1¼ cup besan (chickpea flour)
 - ½ onion, chopped finely
 - ½ teaspoon red chilli powder or 2 small red chillies
 - 1 teaspoon minced garlic or 4 cloves garlic, mashed
 - ½ teaspoon turmeric powder
 - ½ cup tamarind juice
 - 1 tablespoon oil
 - salt

Directions

1. Mix the ingredients for the spice paste and add a little water if needed so that it does not come out too thick or too runny.
2. Wash and trim the stems off the leaves. Remove a thin layer from the central rib of the leaves to make them more pliable for rolling.
3. For the layering, place an upturned leaf (rib-side up) on a work surface and apply a thin layer of the spice paste.
4. Put another leaf on top and add more paste. Use 4-5 leaves to get a good sized roll.
5. Fold over the sides and use paste to hold them down. Roll as tightly as possible and tie with string. Prepare all the leaves in this manner.
6. Place the logs in a steamer, seam side down, and steam, in a single layer, for 30-40 minutes. [This helps to neutralise the oxalic acid to prevent itchiness.]
7. When cool, remove string and slice into ½ inch thick rounds. Deep fry in hot peanut oil, a couple of minutes on each side, till medium brown in colour. Then drain on paper towels.

Taro leaf curry

Ingredients

- 1 bundle of taro leaves – about 30 leaves, chopped
- 1 onion, chopped coarsely
- 2 cloves garlic, chopped finely
- 2 red chillies, chopped coarsely
- 2 tablespoons cooking oil
- salt

Directions

1. Heat cooking oil and add onion, chillies and garlic.
2. When brown, add taro leaves.
3. Cook on low heat, turning frequently to prevent sticking.
4. When all liquid has evaporated, season with salt.

List of people attending meetings

Farmers' meeting 21 July

MR. Aishath Moosa Delige
Mr. Abdulla Ibrahim Munnarudhoshuge
Mr. Ibrahim Ushakuruge
Mr. Hussein Didi Bulbulaage eirumatheebai
Mr. Zuhuraa Saamiyaana
Mr. Mohamed Thaufeeq Gulzaaruvaadhee
Ms. Raamiza Fahumee Hadhuvareenaaz
Ms. Fathimath Rasheedha iruvaimatheege
Ms. Shameenaa Adam Noomas
Ms. Fathimath Amnike Zeera
Mr. Hassan Ali Kunnaaruge
Mr. Abdulla Ismail Lilyge
Mr. Abdul Hakeem Kudhiliboamaage
Mr. Abdul Muhusin

Farmers met on Gan 24 July

Mr Idris Ali
Mrs Naeema Zahir
Mr Mohamed Kalo

Farmers met on Gan 19 July 25, 2008

Mr. Ali Mohamed
Mr. Abdulla Ibrahim
Ms. Aiminath Didi

Project Gadhdhoo Partnership meeting 27 July