APPENDIX 13

PONDFIELD TARO IRRIGATION AT COL DE LA PIROQUE, NEW CALEDONIA

The irrigated gardens (Fig. 7.4) are situated just to the north of the main road from Tontouta airfield to Nouméa and are the closest to Nouméa of all the operating gardens of this type, being about 40 km distant. This convenience of location has prompted study previous to mine. In his general work on New Caledonian traditional agriculture Barrau (1956) mentions and gives photographs of the taro pondfields there. The geographer Curry visited Col de la Pirogue in 1958-59 and his account of taro culture there was published in Etudes Melanésiennes in 1962. I made three brief visits there, in April 1978, April 1979 and September 1980.

Curry's report gives details of the environmental setting and climate of the area. Rainfall in nearby Nouméa is 1067 mm/annum, with significant moisture deficits occurring from August to January. The account also includes a map of Col de la Pirogue land use in early 1959. There have been some significant changes since then, but I will discuss only those that have affected taro agriculture. The major changes occurred with the nickel boom of the early 1970s when in large parts of New Caledonia traditional agriculture, particularly in its intensive forms such as irrigation, was all but abandoned as the inhabitants flocked to work in the mines or associated jobs. This trend was reversed in the mid-1970s and a general return to the land followed the end of the boom. During the nickel boom it seems that no taro pondfields were constructed at Col de la Pirogue, and 1978 marked the first time for several years that the communal labour of the members of the 'tribe' was mobilised for this purpose. In that year four pondfield terraces were constructed and planted during March and April and in January 1979 three more were brought into commission. At the time of writing seven terraces are in operation, covering an area of about 790 square metres of flooded surface.

In his 1959 map Curry (ibid) shows three areas of irrigated taro gardens, two on steep hillsides (up to 80° according to Barrrau (1956: 76)) and one in the bottom of a small valley. In 1978-9 only one location was being so used, a steep hillside area a little to the

east of one used in 1959. In some of the valley bottoms taro has been planted along streams and lines of drainage and this represents another source of water taro for food as well as of planting material for the terraces. I assume that this was the case as well in the 1950s. The area under irrigated taro is obviously much less than in 1959 but it must be remembered that what we are seeing is a phase of recovery from almost total cessation of irrigated taro agriculture. There may well be an expansion of area planted over the next few years.

The supply canal which fed the terraces until 1980 was a relatively permanent fixture and extensions of the same canal would have fed the two areas of hillside terraces recorded by Curry, the further area being about 1.2 km from the canal source. As used until 1980 the canal was about 700 m long. The dam at the canal source was constructed across the bed of a perennial stream a hundred metres or so north of the reserve boundary. It was a percolation dam made of mud and loose stones. Near the beginning of the canal there were two places where the outer canal bank also consisted of loose stones. These allowed much of the captured stream flow to filter back to the streambed, and during periods of heavy runoff after rain they would have helped to prevent damage to the canal through excessive water flow. The canal was carried over the Sanatorium road in a metal pipe. Previously an open wooden canoe-like trough or pipe was used to carry water over this (and other) defiles, hence the name Col de la Pirogue meaning 'pass of the canoe'. The canal was unlined for most of its course and we can thus expect that considerable seepage losses occurred.

When the canal reached the present terrace area it was between 30 and 50 cm wide with a water depth of 6-8 cm under normal conditions. During bankful conditions it would be about 20 cm deep. The canal flow was 0.01 m^3/second at a point just above the pondfield terraces. Much of the flow was not diverted to the terraces and spilled away through an overflow channel to the valley bottom, another device to prevent damage to the system by excess water which here could cause terrace wash-outs. Some of the canal flow was, however, diverted through a small stone-lined opening down to the top two terraces (see Fig.7.4). This amount of water was enough to provide throughflow for the four terraces in use in 1978 (a planted area of about 540 square metres) and the additional three terraces in use in 1979 (and area of

about 250 square metres) with some outflow remaining. It is clear that a considerably larger area of irrigated taro could have been watered by the canal and that at present water supply does not represent a limiting factor to expansion of the system. The two hillside systems on Curry's map represent an area several times that now in use. In 1980 the canal was replaced by a metal pipe which also provides a piped water supply for the houses in the valley below the pondfields. Water now enters the top pondfield via a pipe with an internal diameter of 4 cm, controlled by a valve.

The presently used terraces are at the upper limit of terrain suitable for irrigation using the water source under discussion, the highest terrace being at about 280-290 m above sea level. The terraces now in use face west. On the hillsides below this, especially on the main spur to the west, extensive areas of old terraces can be seen. At the end of the spur the upper limit for irrigated agriculture has dropped to about 180 m, the supply canal being led along the top of this spur. Far from being the abandoned remnants of a once extensive area of agricultural exploitation, as they have often been viewed, these areas are in fact only in extended fallow and could be brought back into commission at any time (cf. Plate 65). We can assume that as the highest area becomes exhausted the gardens will be moved progressively downhill along the spur towards the west, after which the highest garden area will again be brought back into use after an extended fallow period.

As elsewhere, the width of pondfield terraces varies according to slope, being at Col de la Pirogue generally between one and two metres (Plate 66). The supply channels between terraces are sometimes paved with stones to prevent gullying. The soil pH at the terraces was found to be 5.5 to 6. The decision about where and when to rebuild the terraces appears to be a communal one.

Curry (ibid: 50-52) calculates that the region of Col de la Pirogue suffers frequent and intense droughts, so that irrigation is justified, indeed necessary, to allow year-round taro production. The people there were unanimous that irrigated taro tastes better than dry land taro, while the yield is higher under irrigation, even where it is possible to grow dry land varieties successfully (<u>contra</u> an opinion cited by Curry (ibid: 59)).

As in 1959, there are over 100 people living in the two hamlets that make up Col de la Pirogue. Almost all the men are employed at the airport or in other full-time jobs. Major construction work on the terraces is thus limited to Saturdays and public holidays, so that availability of labour is now the main limit to expansion of the garden area. Traditionally men only helped in the heavy work of the initial phases of terrace reconstruction. Planting, weeding and harvesting were the domain of the women. In symbolic terms taro was seen as a 'female' plant, while the yam was considered 'male'. The former strict sexual division of labour is now breaking down, but it is still true that at Col de la Pirogue most of the work is done by the women. During the week they are the only available labour force.

Pre-planting Preparation

When I visited Col de la Pirogue in late April 1978 the top two terraces had already been prepared and planted (on Easter Monday). The lower two terraces had been cleared of bush, and water had been channelled through to soften the ground (Plate 66). I observed the third terrace being prepared for planting during a morning and planted during the afternoon, and terrace 4 being prepared for planting in the afternoon. The initial preparation of the four terraces had taken place during the previous month. First of all the long grass/wild cane cover was cut and burned and then water was channelled along the terrace lines in order to soften the ground. Weak points at the external edges of the terraces above the steepest slopes were reinforced with wooden stakes and cross-ties, and at these points walkways were constructed with stakes driven into the bank slope at an angle, to allow access to the terrace edges for construction, repair and planting. Five person-hours at least had been expended on this preparatory work at each terrace, a total of 370 person-hours/ha. The time spent may have been as high as 20 person-hours/terrace, or 1480 person-hours/ha.

The final preparation of the third and fourth terraces was undertaken by about 10 to 12 men and women from the two hamlets, with various children and other people helping for short periods of time (Plates 67, 68). About 3½ hours was spent in preparing a terrace with an area of about 135 square metres (90 x 1½ metres). Generally there were three or four separate work teams. A vanguard of one or

two people dug into the bank above the terrace, shifting earth downwards to form the terrace surface and increase terrace width with the aid of shovels, forks or metal crowbars. These latter replace the traditional wooden digging sticks and shovels previously used in this task (cf. Barrau 1956: 52-53). Water was often thrown on the bank to soften the soil and make it easier to work. A start was also made on mixing the earth with the water flowing through in order to create a 'puddled' zone of saturated mud about 10-20 cm deep, in which the taro cuttings would later be planted and the corms subsequently grow. The second group had the mixing of earth and water as their main task, spreading back the fine mud towards the third group. This third group spread the mud in a finer fashion, equalising the terrace surface and also placing mud to form the outer bund (Plate 67). Two people standing below the terrace (often on the walkways mentioned above) formed the fourth group and it was they who completed bund construction. They sifted through the mud for stones which were removed and then spread the mud evenly and smoothed the embankment surface. Internally the bund thus formed was 20-30 cm high and about 40 cm wide. The bunds make the terraces very watertight and very little seepage through them was evident. Water depth within the terraces was 3-5 cm after construction. The canal channel is a permanent feature and had needed only to be weeded and in some parts repaired for it to be ready for re-use.

In January 1979 three new terraces were prepared and planted, final preparation and planting being achieved in one day. The terraces, each about 82.5 square metres (55 x 1.5 m), were directly below and fed by the four terraces constructed in March-April 1978.

I have calculated that the labour expended in final preparation of terraces represents 2590 person-hours/ha. When allowance is made for initial preparation a minimum of 370 person-hours/ha must be added, making a total of 2960 hours. If the higher figure for initial labour requirement is used (1480 hours), then the total becomes 4070 hours. Such figures are only meant to give a general idea of labour requirements, and different garden sites will have different requirements. The labour force involved may vary from hour to hour, making exact calculations difficult, a problem greatly compounded when the process is not directly observed.

Planting

Curry (1962: 53) states that between preparation and planting the terrace is left for a month. The process I observed involved final preparation and planting on the same day. Time of planting may be a question of labour availability or availability of sufficient taro cuttings. The cuttings (stem and 2-3 cm of tuber top) are collected from previously harvested taro and taro growing along streams, drainage lines and the like. Several hundred had been collected and were planted on the third terrace in the afternoon of the same day that terraces 3 and 4 were prepared. They represented several different cultivars, differentiated by stem and root colour and stem size. Three women spaced these cuttings on the terrace bund and within the terrace itself in preparation for planting (Plate 69). At the same time spring onions and sweet potato cuttings were planted alternately along the terrace bund, helping to stablilise it. On the banks of terraces previously prepared, sugarcane had been planted. Bananas are put on sufficiently large areas of slope between terraces, where the growing taros will not be overshadowed. The sweet potato vines are trailed downslope. Curry (ibid) reports that dry land taros as well as various ornamental plants are also sometimes planted on the bunds.

All the taros on the third terrace were planted by one woman in one afternoon. The tool used to make the planting hole was a small wooden digging stick, about 1.2 m long and sharpened at one end. The digging stick was thrust once or twice into the mud and worked to and fro to make a hole large enough to insert the taro cutting (Plate 70). The time taken in this operation was about 25 seconds/plant. Depending on terrace width there will be two or three rows of cuttings planted. The larger stems were generally planted adjacent to the bund, but I could not obtain any clear information on which varieties were placed where. I would assume that, as on Maewo, the most quickly growing varieties would be placed nearest the bund so that they could be easily harvested, with the more slowly growing ones placed behind. The average spacing in a measured area was about 60 x 60 cm, although some taros were as close as 45 cm. Curry (ibid: 52) records the spacing as being between 35 and 50 cm. It may well be that on subsequent plantings spacing is reduced, as is sometimes the practice on Maewo, and that it was this that Curry observed. A spacing average of

62 x 62 cm gives 26,000 plants/ha. There were about 400 plants in the top terrace, making 29,600 plants/ha, an average spacing of about 58-59 cm. I have used an average figure of 27,800 plants/ha in calculations.

In January 1979 planting of the three new terraces (5, 6 and 7) took place in one day. Barrau (1956: 79) records two taro planting seasons as usual for New Caledonia - one from September to January, another from May to June.

At Col de la Pirogue I collected the names of nineteen wet taro cultivars, and I am sure this is by no means an exhaustive list. Many cultivars formerly grown have no doubt been lost since European colonisation and the resultant decline in taro growing.

Between Planting and Harvest

I did not observe the tasks that take place between planting and harvesting. Barrau (ibid: 80) lists them as follows:

1. One or two months after planting, the terraces are weeded and the roots are pulled up slightly out of the fine mud which has covered them.
2. After four months a second weeding takes place and at the same time a little earth is banked up around the foot of each plant as the corm starts to push up out of the ground.
3. After eight months a third weeding takes place and earth is banked up around the foot of the plant to encourage the growth of new shoots. Sometimes a pebble (or a piece of wood) is placed between the rhizomes to keep them apart.

Curry (1962: 53) gives a similar account, adding that if the harvest seems likely to be good, earth will be banked up round the plants a second time.

4. At maturity the water flow is considerably reduced to allow harvest of the taro under nearly dry conditions. This reduction in flow will not of course take place if harvesting and replanting are continuous, or if there are terraces below in a less advanced stage of development where a reduction of water supply would impede growth of the plants.

Additional tasks as described to me include repairing the bunds, when necessary, and weeding the 700 m long canal. This was said to be necessary five times in a year. It takes a day of communal labour

to complete the weeding. In the terraces planted in January 1979, three months previous to my second visit, I saw reed-like weeds but these were not yet choking or overshadowing the young plants. These terraces had not been weeded and it may well be that the first task as described by Barrau may have been since given up, or that in his general account he is recording the practices of another area of New Caledonia. I was told that the first weeding would take place four months after planting and that there would be one or two subsequent weedings. On the basis of information from Maewo, I would estimate that weeding and associated tasks in the pondfield system represent about 1200 person-hours/ha/year. The figure indeed may be less.

Harvest, Replanting and Fallow

The plant matures in about twelve months. Harvesting the mature plant takes about 1 minute/plant, requiring at Col de la Pirogue a labour in total of 463 person-hours/ha at a plant spacing of 27,800 plants/ha. The plants are pulled up by the stems, a digging stick being sometimes used to break up the root system. The taro is harvested as needed and immediate replanting of cuttings takes place. I have no data on yields from Col de la Pirogue. On my return visit in April 1979 the taro planted a year previously was ready for harvesting. A small area of the top terrace had already been harvested and replanted. The rest of the ripe taro would have been harvested during the following months from Terraces 1 and 2 and replanting would have been continuous with this. In September 1980 only some of the daughter plants of the second planting were left, water flow was sluggish and large bunches of weeds were apparent. Terraces 3 and 4 would have been harvested and replanted sometime after my April 1979 visit. In September 1980 terrace 3 was as weedy as terraces 1 and 2 and in parts very few taros remained. Terrace 4 was completely overgrown with weeds but some daughter plants remained. In the top four terraces two cycles of use were nearing completion and it looked as though they would then be left fallow. As Chief Paita remarked, 'Now it is dirty because we are eating the taros'.

In terraces 5, 6 and 7, originally planted in January 1979, the situation was somewhat different in September 1980. At the western end of terrace 5 were some newly planted taros and a bunch of tops ready for planting. The bank upslope had recently been weeded. Taros in the rest of the bed were ready for harvest and there was another

patch of newly planted taro at the eastern end. Where there were newly planted taros the water appeared to have been channelled along the back edge of the pondfield and the tops planted in soft mud presumably to allow them to set roots before being totally submerged. Terrace 6 was overgrown at its western end, which had become completely dry. The eastern third of the terrace had been weeded and water channelled along the back edge. Only daughter plants remained in place, the main corms having already been harvested. The plot appeared to be ready for replanting. In the lowest terrace the taros were reaching or had reached maturity. Weeds had started to invade the terrace and the water flow was small and to some extent canalised towards the back of the terrace. For terraces 5, 6 and 7 one cycle appeared to be at an end and replanting for the second cycle had begun in terrace 5 and appeared imminent in terrace 6. The taros had been field stored for up to eight months in the terraces; I was told that after maturity taro can be stored in place for up to a year (Curry (1962: 60) claims up to two or three years), but once it has been harvested it will only keep for two or three days in the house before going dry. It was not clear whether the cormels remaining in the terraces could be eaten or were solely for use as planting material. As on Maewo, the presence of blue-green algae, which was found in quantity in all of the terraces, may be significant in terms of the nutrient cycle in the pondfields.

Barrau (1956: 80) posits a pre-European pattern of one year's use, three years fallow until the ground showed a serious decline in fertility, when gardens would be moved to a new site. At Col de la Pirogue, because of the decline in population and the reduced area under cultivation, he observed a pattern of one year's use and an extended fallow period of up to fifteen years (ibid). For New Caledonia generally Bourret (1978: 61) has observed a cycle of one to three years use followed by five to seven years minimum of fallow. At Col de la Pirogue the only apparent innovation in the traditional technology has been steel tools (labour inputs in a pre-steel economy are discussed in App. 4). Fertilizers and herbicides are not used at present.

Labour Requirements: Summary

	(Steel) Minimum Figure	(Steel) Maximum Figure
Initial preparation	2960	4070
Planting	193	193
Weeding, etc	1200	1200
Harvesting	463	463
Person-hours/ha/year	4816	5926

Assuming a two-year cycle of use these figures would average out to 3336 (minimum) and 3891 (maximum) person-hours/year, as initial preparation is only necessary once in the cycle.

	(Pre-Steel) Minimum Figure	(Pre-Steel) Maximum Figure
Initial preparation	6216	8547
Planting	193	193
Weeding, etc	1200	1200
Harvesting	463	463
Person-hours/ha/year	8072	10,403

Initial preparation tasks are calculated as taking 2.1 times as long in a pre-steel economy (cf. App. 4). Assuming a two-year cycle of use, the above figures average out to 4964 (minimum) and 6130 (maximum) person-hours/ha/year.