5

Gardens and *wantoks*

Glenn Banks

This chapter is designed to illuminate the significance of the subsistence sector in the local economy during the development of the Porgera mine. I begin by detailing the physical environment at Porgera which acts as the ultimate constraint on the productivity of the subsistence system. The Porgeran gardening system prior to the start of mine construction is then described, and the effect of the mine development on the gardening system is investigated, firstly in general terms and then focussing on two areas within the Special Mining Lease (SML) where the agricultural system is under stress.

The basic demographic and economic information on the 'outsiders' (*epo atene*—'come stay') from the surveys carried out in late 1992 and mid 1993 as part of the Economic Modelling Project within the Porgera Social Monitoring Programme is then presented. The *epo atene* make up a significant proportion of the population, and play a key role in the dynamics of the local economy. Finally, I draw together the material on the subsistence sector and the *epo atene*, placing both of them in the context of the total Porgeran economy at that point in time.

The results of a number of separate investigations are described in this chapter, drawing on primary and secondary sources. A review of the literature on local gardening systems forms a basis from which the

effects of the mine can be discussed. Most of the substantive work was commissioned by the Porgera Joint Venture (PJV) prior to mine development, though some information also exists in patrol reports and in other studies by anthropologists and agriculturalists.

A central part of our own investigations was a survey which questioned people as to the food they had eaten in the previous 24 hours. For convenience, it is referred to as the 'diet survey', although I stress that it was not a full dietary or nutritional survey. The aim was to investigate the contribution of the subsistence component of the economy or, put another way, the extent to which the population was still dependent on food from their gardens. In total, 350 interviews were completed by the team, each lasting between 10 and 15 minutes.¹ Three areas within the SML (Apalaka, Yarik, Kulapi) and five outside the SML (Mungalep, Anawe, Paiam, Porgera Station, Tipinini) were visited. This represents a cross-section of the communities within the Porgera Valley. The survey was carried out from Wednesday to Saturday in a week in June which was a government (but not a PJV) pay week.

My previous comments on the accuracy of data from such surveys (see Chapter 3) apply to this one as well, although the very immediate and non-sensitive nature of the questions being asked should provide information that is more reliable than the average. There were no independent means by which to confirm the information given, though casual observation of cases of tinned fish and large bags of rice being carried by people in all parts of the valley confirmed their popularity. No information was collected on the amount of each food type consumed—the survey asked only whether or not the respondent had eaten various types of food in the previous 24 hours. Ultimately, this must limit the conclusions which can be drawn from the data, but the survey still provides a useful indication of consumption patterns across certain groups.

During the first week of fieldwork at Porgera we encountered community concern within the relocation areas over the pressure on gardening land. This concern was acknowledged as genuine by PJV Community Affairs staff, and the impact of future dumping in the Anjolek was seen as worsening this problem. As a result, the second week of fieldwork was directed towards a study of the availability and suitability of gardening land within the SML. Kulapi and Apalaka were the two areas investigated in detail. Twenty-two households in Apalaka and 18 in Kulapi were surveyed as to the extent of their

garden holdings. The households chosen were simply those whose heads happened to be around on the three days we visited each settlement. The investigations involved interviewing the head of household as to the make-up of the household, the numbers of its pigs, access to land in other parts of the valley, and the number of gardens held, and then visiting the gardens with the interviewee. Wherever possible, all the gardens belonging to these households were visited, though some respondents did not want to visit their more distant gardens. At each garden we visited, the size, shape and intensity of cultivation were measured. Air photo analysis was used to compare the extent of gardens in 1971 (for Apalaka) and 1986 with the situation in December 1991, and contour maps provided a means of assessing the average slope angle for the various gardening areas.

The subsistence sector in the economy

The subsistence sector at Porgera has been described in a number of studies. However, these papers and reports all pre-date the mine, and no available information documents the changes in the subsistence system since the start of mine construction in 1989. From the earliest European contact, Porgera's subsistence agriculture has been viewed as less productive than that practised in other parts of the highlands. The early patrols from Wabag to Porgera in the late 1940s described the gardens of Tipinini and Porgera as being poor compared to the rest of Enga. Patrol reports noted the 'blue shale' rocks from which the 'poor' soils derive, and also the lack of surplus food available for exchange with the patrols. In the first ethnographic study of the Ipili, Meggitt (1957) also noted the blue shale soils of the Upper Porgera, with better, blacker soils downstream—though neither type was regarded as particularly fertile.

In spite of its low productivity, subsistence agriculture was still the most important element in the Porgeran economy prior to the start of the mine, its output being valued at an estimated K3 million in 1987 (Pacific Agribusiness 1987[1]:41, 45). In 1993, it remained a key element of the economy, even in those communities most affected by the mine and the consequent influx of cash.

The physical environment

The physical environment exercises a basic constraint on Porgeran agriculture. Soil fertility, slope angles, altitude and climate all act to inhibit the productivity of the gardening system. Recent changes, such

as the massive in-migration and the loss of gardening land to the mine operation, have exaggerated the effect of these environmental factors.

Generally speaking, soil fertility is lower at Porgera than in valleys to the east, although soils exhibit extreme variability in fertility within small areas. The greatest fertility occurs on the flatter ridges and in pockets on steeper slopes (Pacific Agribusiness 1987[1]:29). Soils in the area are derived from sedimentary and colluvial material, and lack the depths of volcanic ash which appear in profiles to the east. Goldsmith and Mules (1990), in their geomorphic mapping of the Porgera area, distinguished between the colluvial bench land terrain (derived from the steep limestone terrain behind), which covers much of the lower portions of the valley, and the mudstone ridge and V-valley terrain of the Kaiya River area. These differences are significant for the Apalaka and Kulapi examples discussed below. For the moment though, this distinction highlights general variations in soil types, with the colluvial material tending to have relatively deep, peaty/clayey soils, and poor drainage. This compares with the generally shallower, better-drained soils which developed from the mudstone shales (Mules 1993).

The Porgeran climate is characterised as lower montane perhumid (McAlpine and Keig 1983, cited in NSR 1988). The meteorological data recorded at the Alipis mine site since 1974 shows average annual rainfall to be 3,678 mm per year. Data for 1991, from three other stations within a 10 km radius, reveal the marked influence of local topography and orographic effects on rainfall magnitude and intensity (PJV 1993:6). Although there is little seasonality in rainfall, the monthly totals can vary significantly, with the highest and lowest monthly totals recorded being 909 mm and 84 mm respectively. There are relatively few rainless periods of more than four days and droughts are rare. The absence of a distinctive drier season limits the occurrence of frosts relative to other parts of the highlands.² Linked to the high rainfall is regular extensive cloud cover, particularly in the higher altitudes. The mean daily temperature range for the Alipis mine site is 11–22° celsius, with little variation through the year. There is an average of 3.9 hours of sunshine per day, also with little annual variation. Wind speeds in the Porgera Valley are generally low.

The Porgera Valley has an altitudinal range from around 1,800 m (at the Kaiya River) to 3,500 m. According to Hughes and Sullivan (1988:5) the lower temperatures at higher altitudes limit the number of food crops that can be grown, as well as their yields. They compared

the altitudinal limits of sweet potato gardens elsewhere in the highlands (productive to 2,700 m, with an absolute limit of 2850 m) with their observation that the upper limit of gardening averaged 2,400 m at Porgera. On this basis, they proposed that there was

...a strip of forested land about 60 km² in area and up to 3 km wide around the rim of the valley which may be capable of being cultivated, depending on factors such as soil fertility, but which is at present not utilised for that purpose. This area represents about 25 per cent of the potentially cultivable land in the valley.

This observation was used as the basis for statements in the Porgera Environmental Plan (NSR 1988) to the effect that expansion of agriculture above the existing altitudinal limits up to 2,700 m was one way to ease the increasing stress that would be placed on the agricultural system.

While the altitude/temperature relationship generally holds true, the relationship in any given location is also significantly affected by factors such as topography, aspect, rainfall and cloudiness. More specifically, at Porgera it is likely that the greater cloudiness and rainfall, compared to most other parts of the highlands, will significantly reduce the altitudinal limits of crops (and their yields) below the maximum levels recorded elsewhere. Significant expansions of productive gardens above 2,400 m may well not be feasible. During fieldwork in November 1992, it was noted that the highest house and garden on the Waile Creek road was at 2,650 m. However, this is not conclusive evidence that widespread expansion of gardens to this altitude is generally possible, since the garden there was very recent, and it is not clear how productive such gardens are in the Porgeran context.

The topography of the upper Porgera area necessitates that gardens are often constructed on slopes that would be considered steep elsewhere in the highlands. Allen (1982:98) and Scott and Pain (1982:137) both report findings from elsewhere in Enga where slopes over 35° are considered unsuitable for cultivation and are only used for hunting and pig foraging. The average slope of the gardens measured at Apalaka was 27°, and a quarter were 35° or over. Meggitt (1957:36) described Porgeran gardens as being on steep slopes, although his observation that 'few gardens are less than 40° to 50° from the horizontal, most are 50° to 60°, and a few are from 70° to 75°' is clearly an exaggeration. According to Bourke and Lea (1982:82), all the evidence shows that yields are greatest on slopes of 10° or less.

Slope angle acts as a constraint on the productivity of an agricultural system in several ways. Most obviously, the long-term productivity of the garden is reduced through the increased soil erosion which is likely to occur on slopes over 15° (Allen 1982:103–4). Gardening on steep slopes also probably requires greater energy inputs from gardeners than the equivalent garden on the flat.

The gardening system

As with the rest of Enga, the Porgeran subsistence agricultural system (as it existed before the development of the mine) is based on the sweet potato, which is universally grown in mounded gardens. A range of other crops—primarily pitpit, sugarcane, ‘true’ (indigenous) taro, corn, beans, cabbage, several species of greens and potatoes—are generally planted between, or on the periphery of, these sweet potato mounds.

Three main types of garden are generally distinguished (Pacific Agribusiness 1987[1]:26–7).

- First, there are the initial mixed gardens which are established after clearing of primary forest or secondary growth. A wide range of food and fibre plants are grown, though few if any sweet potato mounds are present.
- Mounded sweet potato gardens are generally established during the second cultivation of a mixed garden. The range of secondary crops is reduced as the area given over to sweet potato mounds increases (Pacific Agribusiness 1987[1]:28).
- The final type of garden is a house (or kitchen) garden surrounding the house, usually planted with vegetables (beans and cabbages are common) and sugarcane.

As in the rest of Enga (see Waddell 1972:42–49), two main types of sweet potato mounds are found at Porgera—composted (*mondo*) and uncomposted (*yukusi*). Composted mounds are formed by placing compost between existing mounds, allowing it to decompose, and then covering it with soil (Bourke and Lea 1982:80–1). Composted mounds at Porgera are up to 2 m in diameter and one metre high. Uncomposted mounds are found on steeper slopes, and are generally thought to be either an initial stage prior to the establishment of a *mondo* garden, or a simple rotational fallow with one or two successive plantings followed by lengthy fallows (Bourke and Lea 1982:81). These uncomposted mounds are smaller, often little more than 75 cm in diameter and

20 cm in height, and are 'usually associated with soils deriving from sedimentary bedrock' (Wohlt 1986:8).

Data collected by Wohlt (1986) showed the average Porgeran composted mound to be 1.46 m in diameter, significantly less than the average for Enga of 2.7 m, resulting in a smaller area per mound (1.7 m² compared to 5.7 m²). Mounds were also lower in height in Porgera (61 cm compared to 75 cm), were more tightly grouped (2.29 m average spacing between mounds compared to 3.39 m for Enga), resulting in a higher mound density per hectare (1,901 compared to 866). They tended to have fewer vines planted per mound (28.1 compared to 48.7), but had higher planting densities per square metre of mound (16.8 compared to 8.5), and consequently a higher planting density of vines per hectare (53,443 compared to 42,291). Wohlt comments that

[t]he Porgera figures make sense if the low proportion of garden in mounds implies poor soils or thin topsoils...and the high numbers of vines per square metre on the mound is an attempt to maximise the use of the soil thus concentrated.

Pandanus (*Pandanus julianetti*), the nuts of which are highly prized as food, are common within these sweet potato gardens, and are managed by a form of silviculture (Pacific Agribusiness 1987[1]:26). Plantings of *yar* trees (*Casuarina oligodon*) for timber generally occur within or on the fringe of the gardens, and these trees also have nitrogen fixing properties (Bourke and Lea 1982:80).

After three or four years with composted sweet potato mounds, the land is left to fallow.³ Tall sword grass (*Miscanthus floridus*), shrubs and trees dominate the fallow regrowth (Hughes and Sullivan 1988:9). The length of fallow is dependent on soil fertility and population pressure. Historically, Meggitt (1957) described the fallows as 'inter-generational', while the Social and Economic Impact Study (SEIS) describes fallows as being 'generally within the five to ten year range' at Porgera (Pacific Agribusiness 1987:29). A systematic survey of PNG agricultural systems has recently estimated the Porgera fallows to last longer than 15 years (Allen *et al.* 1995).

As in other parts of Enga, pigs are an integral part of the agricultural system (Bourke and Lea 1982:85). Wohlt (1986) shows that Porgera had the lowest ratio of pigs per person (0.61:1) in Enga Province. The gardens in use in 1993 were fenced to exclude pigs, but it is likely that pigs till and manure old gardens, as they do in the rest of Enga. They generally forage in forests and around houses during the day and are fed on inferior garden produce.

The garden surveys carried out by Jackson (1987) covered 43 households in the Porgera area and provided detailed information on the gardening system. Table 5.1 shows the approximate crop intensities which Jackson derived from the survey. He noted that the figures are inclusive, in the sense that all the crops were found together. Various other minor crops were also found, including pitpit, corn, pumpkin, greens and some crops, such as 'grass skirt' and 'rope' plants, which are normally 'bush' plants but are occasionally cultivated. There were variations in the figures for different communities—Suyan, for example, was found to have 60 per cent more crops per cultivated hectare than the average, compensating perhaps for that community's lower garden area per household. The ratio between sweet potato and taro also varied considerably, from 9:1 and 8:1 for Anawe and Alipis respectively down to 2:1 for Mungalep, and Jackson thought that there might be a link between recent immigration and the predominance of sweet potato.

Various estimates have been made of the amount of gardening land available per household. The Porgeran agricultural system has generally been described as a low intensity system prior to the development of the mine, with a refined population density⁴ of about 22 persons per square kilometre (Lea and Gray 1984, cited in Hughes and Sullivan 1988:4). This indicates that population pressure on land was low, and the agricultural system was sustainable. Meggitt (1957) noted that Porgeran gardens were larger than those in other parts of Enga, averaging between 0.3 and 0.4 hectares in area. Bourke and Lea (1982) report per capita (rather than per household) garden areas for Enga as a whole ranging from 0.05 hectares in the Upper Lai Valley up to 0.17 hectares in the Wapenamanda area. Allen (1982) found that three communities in Enga had between 0.24 and 0.31 hectares of cultivated land per person, while a generally accepted average for the highlands is 0.1 hectares of garden per person (Robin Hide, pers. comm.).

Jackson's (1987) survey found significant variations in garden area per household within the Porgera Valley (see Table 5.2). Jackson hypothesised that variations in household size (for which he had no data) may have been significant in explaining the variations in the garden area per household, or alternatively

the Alipis residents may have been using far more land than is normal in the Porgera valley—since this is not for cash crops, other reasons, including anticipated compensation, would need to be looked into.

Table 5.1 Crop and tree densities in the Porgera area, 1987

Crop	Unit	No. per hectare	No. per garden
Sweet potato	Mounds	2,100	1,150
Taro	Plants	350	190
Sugarcane	Clumps	140	75
Banana	Clumps	30	16
Pandanus	Plants	125	65
<i>Tanget</i>	Plants	350	190
<i>Yar</i> (Casuarina)	Plants	110	60

Source: Jackson, R.T., 1987. *Social Survey: Porgera*, Department of Geography, James Cook University for Placer Pacific Pty Ltd, Townsville: Table G-2.

Table 5.2 Porgera garden survey data, 1987

Community	Households surveyed	Mean gardens per household (metres)	Mean distance from household (hectares)	Mean size of garden	Garden area per household (mean) (range)
Mungalep	10	4.8	575	0.29	1.39 0.63–3.34
Anawe	10	3.8	613	0.64	2.43 0.45–5.31
Alipis	10	5.2	2,342	0.64	3.33 1.17–6.14
Suyan	10	2.8	244	0.19	0.53 0.29–1.18
Paiam	3	4.3	n.a.	0.14	0.60 0.30–0.86

Source: Jackson, R.T., 1987. *Social Survey: Porgera*, Department of Geography, James Cook University for Placer Pacific Pty Ltd, Townsville: Table G-.

The SEIS included surveys of 11 gardens amongst SML landowning clans. The average total area of an average of four gardens per household (with an average of six members) was 0.86 hectares, lower than the averages found by Jackson. It was estimated that a five-year fallow period would mean that each household required 4.86 hectares of garden land, while a ten-year fallow required 8.86 hectares per household.

Food shortages have occurred in the past at Porgera. The valley was visited in 1981 as part of an investigation into widespread food shortages in Papua New Guinea, carried out for the Director of National Emergency Services and Civil Defence (Wohlt *et al.* 1981). The study team noted that short-term (two to three month) food shortages were relatively common in Porgera, but longer-term shortages, when many Porgerans would have moved to stay with kin

in the Wage Valley or the Tari area, were rare. The best explanation the team could find for this particular shortage was excessive rain in previous months, which gave rise to vigorous sweet potato vine growth but poor tuber development. The upper Porgera area was less affected than Kairik and Tipinini in 1981, partly as a result of cash income from alluvial mining being used to supplement garden foods. Yields from gardens being harvested were substantially down on the norm, and tubers were generally less than half the normal weight of 500 grams.

The impact of the mine

The SEIS noted that the Porgeran subsistence system is adaptable and dynamic (Pacific Agribusiness 1987). This is reflected in the way in which the system has adapted to the massive social, environmental and economic changes which have occurred since the start of mine production. The most significant changes which have impacted on the gardening system are the loss of land for the mining operation, the large influx of non-Porgerans, and the substantial amounts of cash which have been paid out by the PJV.

It was recognised, in studies conducted before the development of the mine, that the loss of gardening land within and around the SML could create major problems for some people (see Jackson 1987; Pacific Agribusiness 1987; Hughes and Sullivan 1988; NSR 1988:57). This was expected to be countered by the increasing cash-earning opportunities that would be available to the groups most affected. The Environmental Plan (NSR 1988) contended that the three most affected clans (presumably Tieni, Pulumaini and Angalaini) had

...already changed their economic base from pure subsistence to cash. The effects have been relative material wealth, modern leisure activities, a diet dominated by trade store foods and a relatively higher nutritional status, compared to outlying villages in Porgera and elsewhere in Enga. These economic trends have reduced reliance on subsistence agricultural resources.

At the wider valley scale, the impact of the project on gardening land was expected to be minor, as the mine would need only 2 per cent of the 230 km² of potentially cultivable land in the Porgera Valley. A number of 'safeguards' were expected to combine to ameliorate any adverse effects on gardening land over the life of the mine. These included the extension of land under cultivation to currently unused areas up to 2,700 m; reduction of fallows at lower elevations; introduction of new cultivars, composting systems and crops; and

monetary compensation for gardens lost. Increased cash incomes associated with the mine were seen as reducing the dependence on gardens for food. In the longer term, with the closure of the mine, it was acknowledged that there might be a 'subsistence resource crisis', as employment and other sources of funds were lost.

Three more recent surveys have, as part of wider aims, assessed changes in the number of food gardens used by households in various parts of Porgera. The household survey carried out at the end of 1992 (see Chapter 3) asked respondents about the number (but not the area) of food gardens they had under cultivation. Bonnell carried out a similar exercise in a survey of 96 of the relocation homes (see Chapter 4). The diet survey carried out as part of the present study again asked a similar question. The results of these surveys are shown in Table 5.3, with the emphasis on the communities within the SML and at Tipinini, the area least affected by the mine development. This table shows averages for the entire valley of 3.1, 2.1 and 2.3 gardens per household respectively for the three surveys. The differences can be explained partly by the geographic spread of each of the surveys, and partly by the target group (relocation households versus more general groups). Several trends are evident in the data—Apalaka and Yarik appear to have more gardens than most other parts of the valley, while Kulapi has significantly fewer. These communities will be discussed in more detail below.

One very significant trend is the number of households in Porgera without gardens. This came out particularly in Bonnell's study of the relocated households, with 15 per cent of households having no food gardens. The diet survey figures showed that, among the SML communities, Kulapi had the most serious problem, with 26 per cent of households reporting no gardens, while Apalaka and Yarik had figures of 0 and 9 per cent respectively. Other parts of the valley, particularly those which had recently experienced large increases in the number of non-Porgerans living in the community, had significantly higher proportions of garden-less households. Of those interviewed at Porgera Station, for example, 53 per cent had no gardens in the valley, though it needs to be pointed out that most of those interviewed there were not Porgerans.

Table 5.4, based on occupation fees paid during 1993, shows the extent of the impact of mine development on the availability of gardening land by subclan group within the SML. The figures showing the proportion of the clan land untouched by the mining operation are the inverse of the proportion which had been cleared, damaged or lost to mine development. The Table shows that certain

subclan groups (particularly the Tieni Waingolo, Yangua and Uape, the Pulumaini Ambo, the Angalaini Mapindaka, and the Tuanda Yapala) had lost large amounts of land in absolute as well as percentage terms. The Pulumaini losses may have been relatively greater, since these involved their lower-altitude gardening lands, and the result was that they had been forced to move into areas of primary forest, above the altitudinal limits of their previous gardens.

Access to land at Porgera for an individual is derived from cognatic kinship links—that is, through rights to land acquired from either parent. The implication of this is that individuals who lost land within the SML may well have had rights to land elsewhere—either in Porgera or further afield. Table 5.4 does not show the extent of subclan landholdings, or access to land, outside the SML boundary. On the

Table 5.3 Household size and garden numbers in recent surveys

Survey and community	Sample size	Mean household size	Gardens per household
1. Household survey 1992			
Apalaka/Yarik	32	7.1	3.8
Tipinini	35	5.7	2.7
Rest of Porgera	55	7.3	3.2
Total	122	6.8	3.1
2. Relocation survey 1993			
Apalaka	15	8.0	2.3
Yarik	21	7.0	4.0
Kulapi	24	8.5	1.2
Rest of Porgera	36	8.5	1.7
Total	96	8.1	2.1
3. Diet survey 1993			
Apalaka	12	10.8	4.3
Yarik	55	8.7	3.2
Kulapi	19	9.0	1.2
Tipinini	49	7.6	1.8
Rest of Porgera	243	7.7	2.1
Total	378	8.0	2.3

Sources: Banks, G., 1993. *Porgera Social Monitoring Programme: economic modelling project—First Report*, Unisearch PNG Pty Ltd for Porgera Joint Venture, Port Moresby; Banks, G., 1994a. *Porgera Economic Modelling Project—Second Report: gardens and wantoks*, Porgera Social Monitoring Programme Report 3, Unisearch PNG Pty Ltd for Porgera Joint Venture Port Moresby; Bonnell, S., 1994. *Dilemmas of Development: social change in Porgera, 1989–1993*, Porgera Social Monitoring Programme Report 2, Subada Consulting Pty Ltd for Porgera Joint Venture, Thornlands (Qld).

other hand, there is no guarantee that individuals who had lost land were automatically able to exercise rights to other pieces of their subclan's land outside this boundary. Three questions which thus arise in the context of loss of garden land are

- the extent of subclan land ownership outside the SML boundary for those subclans listed in Table 5.4
- the extent to which individuals had retained and maintained rights to other land outside the SML; and
- the nature of the current mechanisms and authorities for handling disputes over land, in a context where land was being lost to the mine and the population was increasing.

The continuing economic significance of the subsistence sector, in spite of the large amounts of compensation which had been paid out

Table 5.4 Effect of mine development on land by subclan within the SML, 1993

Clan/subclan	Area owned in SML (hectares)	Area untouched by mining operation (hectares) (per cent)	
Tiene/Waingolo	299.0	61.9	20.7
Tiene/Yangua	186.0	37.0	19.9
Tiene/Uape	269.0	145.5	54.1
Tiene/Lagima	89.0	78.4	88.1
Tiene/Kaimalo	32.0	11.0	34.4
Tiene/Akira	21.0	21.0	100.0
Pulumaini/Paramba	56.0	38.0	67.9
Pulumaini/Ambo	257.0	157.3	61.2
Pulumaini/Epeyea	21.0	-	-
Pulumaini/Yunga	22.0	22.0	100.0
Anga	2.0	2.0	100.0
Mamai/Andapo	9.0	9.0	100.0
Mamai/Kenja	54.0	28.0	51.9
Waiwa	54.0	32.9	60.9
Angalaini/Piko	40.0	35.1	87.8
Angalaini/Mapindaka (Yunguna)	103.0	60.3	58.5
Angalaini/Woyopen (Taunga)	67.0	67.0	100.0
Tuanda/Yapala	332.0	223.1	67.2
Tuanda/Ulupa	309.0	289.9	93.8
Pakean/Ringime	6.0	6.0	100.0
Total	2,228.0	1,319.0	59.2

Source: PJV records.

by PJV, emerged as a significant finding of the first phase of my study (see Chapter 3). The income and expenditure survey carried out in 1992 highlighted the inequalities in cash income in Porgera, with the top 10 per cent of the sample earning 54.8 per cent of the income, and the bottom 50 per cent earning just 2.6 per cent of the income. Of the sample of 220 interviewed, 40 individuals (18 per cent) reported no monetary income in the previous fortnight, and a further 25 (11 per cent) reported less than K10. When asked how they survived, those with little or no income were evenly split between those who relied on *wantoks*, and those who lived off food from their own gardens.

The 1993 diet survey revealed some significant patterns in the consumption of different food types, particularly the difference between subsistence garden food and store-bought food. Table 5.5 shows the proportion of respondents in different parts of the valley who had eaten tinned fish, rice, sweet potato (from their own garden), and greens (from their own garden). A probable interpretation of this data is as follows: people within the SML were eating relatively high proportions of store-bought food, but a significant proportion were also still consuming food from their own gardens. People living in communities outside the SML which had experienced large inflows of *wantoks* and others (that is Anawe/Paiam and Porgera Station) had a higher proportion of store-bought food and, for Porgera Station at least, lower levels of food grown in their own gardens. The communities outside the SML which had been less impacted by immigration (Mungalep and Tipinini) showed very low proportions of store-bought food, and high levels of food from their own gardens—everyone in Tipinini, for example, had eaten sweet potato (*kaukau*) in the previous 24 hours, and only two (out of 49) had eaten tinned fish.

Of the 380 people in the total sample, 329 people (87 per cent) had eaten *kaukau* in the previous 24 hours, and 226 (70 per cent) had obtained it from their own gardens; 193 (51 per cent) had eaten no store-bought food, and 57 (15 per cent) of them had eaten only *kaukau*. Only 28 people (7 per cent) had eaten solely store-bought food. These figures underline the fact that the bulk of the population in Porgera were still dependent on the subsistence sector for meeting at least part of their basic food requirements.

There is some evidence to support the assumption made in most of the studies done prior to mine development, that the loss of gardening land would be balanced by more cash and a shift to store-bought goods. If Tipinini is taken as a 'control', then it is clear that there was a

**Table 5.5 Percentage of community members consuming food types
in the previous 24 hours**

Community	Sample (N)	Tinned fish (%)	Rice (%)	Sweet potato (%)	Greens (%)
Apalaka/Yarik	67	43	48	78	42
Kulapi	19	68	74	21	42
Mungalep	53	13	17	89	70
Anawe/Paiam	84	44	51	75	50
Porgera Station	96	56	59	47	33
Tipinini	49	4	2	100	69
Other	12	33	58	50	33
Total	380	38	43	70	49

Source: Porgera diet survey, 1993.

greater amount of store-bought food being consumed in 1993. However, even in the relocation areas most directly affected by mine development, the bulk of the population had eaten food from their own gardens in the previous 24 hours. There is obviously no linear relationship between the amount of cash going into a community and the switch to store-bought food.

There were differences in the foods eaten by male and females. The sample was made up of 263 males and 117 females. Fewer women had eaten tinned fish (31 per cent) or rice (38 per cent) in the previous 24 hours than men (42 per cent and 45 per cent respectively). The foods eaten also varied by the age of the respondents, with the proportion of people reporting *kaukau* from their own garden rising from 57 per cent for the 16–19 age group, to 82 per cent for the 40–49 age group, and 73 per cent for those 50 years and over. Taro consumption was even more influenced by age—from less than 10 per cent of those aged under 30 years, to 36 per cent of those aged 50 years and over.

It is also reasonable to expect to find variations in food consumption through the fortnightly pay period. As noted earlier, the survey was carried out during a government pay week—between a week and ten days after the more significant PJV pay Wednesday. One would have expected higher proportions of tinned fish, rice and other store-bought food to be eaten just after PJV pay days. In SML areas, regular payments such as royalties and occupation fees may well have influenced food consumption for short periods in the same way. Temporal patterns of trade store sales (see Chapter 3) certainly

reflected recent PJV-related inputs, and these patterns of expenditure were probably closely related to food consumption patterns.⁵

In the SEIS, it was estimated that subsistence agriculture was worth K1 per person per day, or a total of K3 million per year in the Porgera Valley as a whole. The 1993 diet survey showed that this figure had probably increased in absolute terms. While there was now greater consumption of trade store-sourced foods, there was also a significant increase in the size of the population being fed, and most people were still reliant on the subsistence sector for many of their food requirements. If we assume that, for the valley as a whole, dependence on garden foods had dropped by 25 per cent, and prices for store-bought food had doubled over the intervening period, it is likely that the average figure per person per day for the value of subsistence food production (or the cost of replacing it with purchased food) was now approximately K1.50. With a population of 12,000 in the valley, this amounted to K6.57 million per annum—slightly less than the K7.3 million of direct PJV cash payments to Porgerans in 1993 (see Chapter 3).

From the data already presented, it is clear that the subsistence sector remained very important to the bulk of the population in Porgera. At the same time, the loss of land, the greater amounts of cash in circulation, and the influx of outsiders had affected the agricultural system in different ways in different parts of the valley. Two of the areas which appeared to be under the greatest stress were Kulapi and Apalaka, and these were chosen for more detailed investigation because they were the areas where most concern was expressed by residents and PJV staff. The aim of this exercise was to establish, in a preliminary way, the extent to which the subsistence gardening sector was under pressure in these two areas.

Apalaka case study

Apalaka is a relocation housing area situated at the end of the road which services the three relocation areas on the southern bank of the Kaiya Valley (see Map 1.1). The Apalaka relocation area was established in 1989, and there were 62 relocation houses in the area in 1993 (with an average of eight persons in each house), as well as a considerable number of bush material homes. Part of the relocation package included K1,400 to assist with the preparation of new food gardens for each household.

The Apalaka area comprises moderate to steep mudstone ridges and slopes, which are generally stable and well-drained. There are

small areas of boulder clay colluviums, and local relief can be very steep. Soils are generally thin and largely residual, derived from the mudstone. Small areas have a greater depth of residual soils or a veneer of colluvium (Mules 1993). From my own brief observations in the field and from anecdotal evidence, it would seem that rainfall is lower at Apalaka than at Alipis. Apalaka, being slightly lower than Alipis and situated on a north-facing slope, should also have slightly warmer temperatures. Contour maps of the Apalaka area indicate that slopes average around 16.5°, though there is great variability, and the houses tend to be grouped on the flattest land, leaving the steeper slopes for gardens. The gardening areas range in altitude from 2,000 m on the banks of the Kaiya River to around 2,450 m on the slopes of Waruwari ridge, but most of the gardens are in the range between 2,100 m and 2,200 m. Air photographs show that the area around Apalaka has been used for gardening for many years. A set taken in 1971 shows that around 60 per cent of the area which was under cultivation in 1993 had already been cleared of primary forest for more than twenty years.

The Tuanda clan has primary rights to the land around Apalaka, including most of the land to the west of Yambu Creek, while the Waiwa clan owns the remaining 54 hectares immediately adjacent to the west bank of the creek. The Tuanda clan also has access to gardening land in the upper reaches of the Kaiya, although the boundaries of this access are not clear. Five out of 22 households interviewed for the garden survey said they had access to land in other areas—two in Laiagam, two at Alipis, and one at Yuyan. It is likely that some of the social changes brought about by the mine (permanent houses, fixed water supplies) had reduced the mobility of households within the SML, in the sense that people might no longer be prepared to walk considerable distances to gardens, and relocated landowners might be less likely to live in ‘multilocal’ households (see Burton 1991:10). These trends would have reduced the likelihood of these households maintaining gardens outside the SML.

Twenty-two households were covered by the garden survey in Apalaka, 13 of which were resident in relocation houses. A total of 31 gardens were surveyed in Apalaka, and these included the complete garden areas of 11 households (see Table 5.6). For these 11 households there was an average of 1.4 gardens per household, averaging 7,173m² in area, giving an average of just over 1 hectare of garden per household. Assuming a constant average garden size, and extrapol-

ating to the gardens which were not surveyed, the average area per household for all 22 Apalaka households in the survey sample would be 2.1 hectares. With a total population of 183 in those households, this gives a mean garden area per person of 2,524 m²—higher than most of the comparable Engan figures discussed earlier. A total of 92 pigs were distributed between 19 of these households, giving an average of 4.84 per household, or a pig-to-person ratio of less than 0.5:1.

The average slope of the 29 gardens inspected in the Apalaka survey was 27°, with a range between 12° and 60°. A quarter of the sample gardens were on slopes of 35° or steeper. As previously mentioned, such slopes are generally regarded as having low productivity, high rates of topsoil depletion, and short effective lives. Fallow periods, to be effective, must be long. Residents were aware of this problem, and expressed concern at the frequent slips and slumps which occurred in the steeper gardens. The steep gardens were notable for their small uncomposted mounds (*yukusi*). Large composted mounds, up to 2 m in diameter and 1 m high, were predominant on the less steep slopes. We were told that, although most of the gardens had been cleared for many years, most had also been replanted after the relocation programme had been completed four years previously. The relatively few newly-planted gardens which we saw were being cut out of short scrub and sword-grass fallow. It seemed likely, in light of the SEIS findings, that the yields in the current gardens would fall rapidly in the next couple of years, particularly from the uncomposted mounds.

Table 5.6 Agricultural resources of Apalaka households, 1993

Variable	Total households in survey sample	Households with total garden area surveyed
Households	22	11
Mean size per garden	8,061 m ²	7,173 m ²
Mean gardens per household	2.63	1.4
Mean household garden area	20,959 m ²	10,043 m ²
Household garden area range	720–75,000 m ²	720–32,250 m ²
Mean household size	8.32	7.9
Mean pigs per household	4.84	2.8
Mean slope angle	27° (29 slopes)	30° (14 slopes)

Source: Porgera garden survey.

Nearly all of the moderate slopes in Apalaka territory were currently covered by gardens (see Map 5.1). A series of air photographs of this area (1971, 1986, 1991) were examined to assess the extent of change over the last 20 years.

- The area between Yambu Creek, the Kaiya River and Anjolek Creek had been under cultivation for many years. Even in 1971, the forest had been cleared to around 2350 m in places.
- Between 1971 and 1986, some areas had changed from gardens to regrowth, and some from regrowth to gardens, but it is not possible to say whether the extent or intensity of cultivation in the area had increased or decreased.
- Finally, the area covered by gardens had increased from 1986 to 1991, and with one exception, these gardens were all within areas which had been cultivated at some time in the past. The exception was that new gardens were being created from primary forest at higher altitudes. There were only a few very small areas which appeared to have reverted from gardens to regrowth over this period. In total, it appeared that there were now more gardens than at any one time in the past.

From the 1991 series, it is possible to make an estimate of the area being cultivated in 1993, although there are major problems with such calculations in areas of steep terrain. Furthermore, it is virtually impossible to distinguish current gardens from gardens which had been abandoned for one to five years. As a result, the figures which follow probably have a large margin of error built into them. Given these limitations, the photographs indicate a total area of around 100 hectares of land available in the territory bounded by Yambu Creek, the Kaiya River, the Anjolek Creek, and the ridge crest which runs almost directly from east to west (Map 5.1). Over 25 per cent of this area was still forested, but much of this was on the walls of steep gullies unsuitable for gardening. Another 4 hectares was taken up by roads and houses, especially the main settlement of Apalaka. This left around 70 hectares in gardens and fallow regrowth. It appears from the photographs as if a greater proportion was now under garden rather than fallow, and despite the reservations noted above, my field observations tended to support this conclusion.

If we follow the SEIS in assuming a figure of 4.86 hectares of garden per household with a five-year fallow period (Pacific Agribusiness 1987), and ignore the greater average household size

Map 5.1 Apalaka garden area, 1993

Banks, G., 1994a. *Porgera Social Monitoring Programme: economic modelling project—first report*, Unisearch PNG Pty Ltd for Porgera Joint Venture, Port Moresby.

found in the garden survey, the 62 relocation households at Apalaka would require 280 hectares of land to support the pre-mine agricultural system. Even allowing for a 25 per cent reduction in the dependence on gardens since 1987, the requirement would still be around 200 hectares, which implies that the Apalaka households must have had other gardens outside the immediate area defined from the air photographs. The implication of all of this is that the existing agricultural system at Apalaka would not be sustainable in the long term, even with greatly reduced fallow periods, if these people had no access to garden land elsewhere. Furthermore, there were numerous gardens and fallow areas (around 15 hectares in all) in the Kaiya 'compensation envelope' which were due to be affected by sediment from the dumping of mine waste in Anjolek Creek over the following 18 months (Parker 1992), and it was possible that additional areas of cultivable land would be lost, either by greater bed aggradation than anticipated, or by the triggering of new landslips or the reactivation of old landslips by the transport of sediment downstream. At the same time, access to Tuanda gardening areas to the west of the Anjolek would become more difficult, unless some positive steps were taken to maintain it.

Kulapi case study

The Kulapi relocation area is adjacent to, and south of, the Anawe plant site (Map 1.1). The gardens associated with the settlement range in altitude from 2,275 m to 2,500 m at the SML boundary, but most of the gardens are at an altitude of around 2,400 m. The gardening area comprises a mix of undulating mudstone ridges and moderate slopes on a boulder clay colluvium resulting from a partially stabilised landslide. Slopes are not as steep as those of Apalaka. The area is cut by three streams, and has several swampy parts. The soils are peaty/clayey, with gravel and large limestone and sandstone boulders, and drainage is generally very poor. Although Kulapi is close to the Alipis meteorological station, anecdotal evidence suggests that rainfall may be slightly higher, and the area is certainly in cloud more often than Alipis and Apalaka. Temperatures may be expected to be a degree or two cooler than Apalaka, given the higher altitude and fewer hours of sunshine. All these factors reduce the rates of growth of agricultural crops (see Chapter 4).

The present settlement of Kulapi dates from 1988, and was the first of the relocation areas to be established. As previously noted, the Pulumaini clan has lost large portions of its land to mine

development, most notably the area which now comprises the Anawe plant site. The Pulumaini had few options for relocation, simply because the portion of their land which was not occupied by mine installations extends uphill from that site. Air photographs from 1986 show dense forest cover over most of the area which now contains Kulapi gardens. Three clearings of less than a hectare are shown on these photographs, the highest of which was at approximately 2,500 m. The upper limit of cultivation was around 2,350 m. As noted above, this is now the lower limit of the garden area. Most of the new gardens were cut from primary forest, and still contained large tree trunks in 1993.

In the Kulapi garden survey, 17 households were interviewed, and in 13 cases, visits were made to all of the household's food gardens. These 13 households had an average of 1.5 gardens each, with an average garden size of 2,890 m², giving a total area per household of roughly half a hectare (see Table 5.7). Extrapolating again to the gardens which we did not visit, we obtain a very similar figure for the average garden area of all 17 households in the sample. Average household size in Kulapi was 11.3, which gives a mean garden area per person of just 470.5 m². Although the survey data indicate a much lower pig-person ratio than at Apalaka, this finding does not tally with our general observations in the Kulapi community, which appeared to have a larger pig population than any other Porgera community we visited.

The average slope angle shown on contour maps of the Kulapi area is around 11°. For the 22 gardens inspected in the Kulapi survey, the

Table 5.7 Agricultural resources of Kulapi households, 1993

Variable	Total households in survey sample	Households with total garden area surveyed
Households	17	13
Mean size per garden	2,797 m ²	2,890 m ²
Mean gardens per household	1.88	1.54
Mean household garden area	5,314 m ²	4,450.4 m ²
Household garden area range	425–8,549 m ²	425–23,608 m ²
Mean household size	11.29	11.6
Mean pigs per household	2.7	2.4
Mean slope angle	17° (22 slopes)	16° (20 slopes)

Source: Porgera garden survey.

average slope was 17°, with a range between 0° and 35°. Mounds varied from quite large (1.5 m diameter) composted *mondo* down to small uncomposted *yukusi* on small areas of steep local relief. The gardens at Kulapi were markedly wetter than at Apalaka, with very poor drainage. Bonnell (Chapter 4) notes that, when they were first cleared, the soils had a high water table, and there was excessive leaf mould with a high nitrogen content. Agricultural experts who visited the area in early 1989 felt that time would cure the drainage and nitrogen problems, though improved agricultural practices would be the only remedy for the poor soil fertility. In fact, four years later, the drainage problems remained. The poor environment for agriculture at Kulapi is confirmed by the fact that relocation gardens took 15 months to start producing *kaukau*, compared to an average of nine months in other relocation areas. The diet survey highlights the gardening problems faced by the Kulapi people. They appear to have been far more dependent on store-bought food than the people at Apalaka and Yarik, and a much lower proportion reported eating *kaukau* from their own gardens in the previous 24 hours (see Table 5.5).

In absolute terms, there was still enough Pulumaini land for additional gardens at Kulapi, above the existing limits of cultivation. In practical terms, however, it was clear that the soils and climate severely restricted yields at the existing altitude, and further expansion up slope would not be desirable. Below the existing altitudinal limit of cultivation, there were only limited areas of forest and fallow remaining. From the 1991 air photographs, it appears that there are roughly 50 hectares of land below that limit, of which 5 hectares had been used for settlements and roads. Small blocks of forest made up another 5 hectares, largely unsuitable for cultivation. A large proportion of the remaining 40 hectares was currently under cultivation, with few areas of fallow (see Map 5.2). The long-term implications for the subsistence component of the economy at Kulapi were obvious and serious.

The role of the *epo atene* in the economy

The issue of ‘outsiders’—the *epo atene* (‘come stay’) people—is interconnected with many of the other social and economic changes that have occurred at Porgera. ‘Outsiders’ place increasing stress on the subsistence sector, they are central to the redistribution of cash out of Porgera, and they are usually involved in social problems such as law and order (see Chapter 2). Burton (1991:4) comments that

Map 5.2 Kulapi garden areas, 1993

Banks, G., 1994a. *Porgera Social Monitoring Programme: economic modelling project—first report*, Unisearch PNG Pty Ltd for Porgera Joint Venture, Port Moresby.

more specifically from the company's point of view, the build up of *epo atene* (non-Porgeran) migrants around the mine area has been perceived as substantial and a threat to the harmony of company-landowner relations, and indeed to development generally.

The diet and income and expenditure surveys revealed some interesting facts about the role of the *epo atene* in the Porgeran economy. Three categories of people are discernible from the surveys—those born in Porgera ('Porgerans'), those born elsewhere but now living in Porgera ('*epo atene*'), and those born elsewhere who are just in Porgera for a short time, visiting relatives or selling goods at the market. These last I call the 'visitors'.⁶

In demographic terms, neither of the survey samples showed any clear distinction between the three groups, although there was a tendency for the Porgerans to be older than the *epo atene* or the visitors. Proportions of males and females varied slightly between each of the groups, but the greatest difference was between surveys, with the income and expenditure survey as a whole having 14 per cent females, and the full diet survey sample having 31 per cent females.

The most interesting result from the income and expenditure survey was the level of income received by each group in the previous two weeks (see Table 5.8). The *epo atene* had an income 50 per cent greater than that of the Porgerans, and they had notably higher earnings from PJV (K106 compared to K44 for Porgerans), while the visitors got more from wantoks (K22 compared to K13 for Porgerans and K10 for *epo atene*). The diet survey revealed slightly different patterns of activity, with more Porgerans in PJV employment, and fewer working for other employers or running their own business. Porgerans, not surprisingly, had more gardens, while visitors had very few, and the *epo atene* fell midway between the two. Significantly, only about 25 per cent of the *epo atene* had no gardens at Porgera.

The diet survey showed a clear division between the Porgerans, who ate the least store-bought food and the most *kaukau* and taro from their own gardens, and the visitors, for whom the proportions were reversed (see Table 5.9). These patterns presumably reflected the amount of garden land and the amount of cash to which each group had access, but they also point to significantly different economic situations and lifestyles for the Porgerans and non-Porgerans in the valley.

The diet survey provides an indication of the variable lengths of time for which the *epo atene* had been living in Porgera (see Figure

5.1).⁷ Most of those who had been in Porgera for less than six months did not have their own home in Porgera, and were staying with *wantoks*, friends or others, and most of these people had come to Porgera to sell food or goods at the markets. The same survey data suggest that 34 per cent of the *epo atene* were from Mulitaka and Laiagam, 28 per cent from the Southern Highlands, and 33 per cent from other parts of Enga. Similar proportions were found among the visitors—20 per cent from Mulitaka and Laiagam, 40 per cent from Tari, and 33 per cent from other parts of Enga.

The non-Porgerans were distributed unevenly within the valley. While they accounted for 40 per cent of the total diet survey sample,⁸ the proportions in each local community varied from just 4 per cent in Tipinini up to 71 per cent of those surveyed at Porgera Station (Table 5.10). Apalaka and Yarik both had low percentages, perhaps reflecting the successful identification of Porgerans (and exclusion of non-Porgerans) during the relocation programme. However, these sample data need to be treated with some caution, because a subsequent census of the Kulapi community found a total population of 730, of whom only 180 (or 25 per cent) were 'outsiders' (B. Robins, pers. comm.).

A comment by Robert Glasse, regarding Huli social structure and dynamics, would seem equally applicable to the situation at Porgera.

Huli have a number of concepts of affiliation and corporate group structure which they use strategically when access to resources is in dispute. In my view these concepts cannot be meaningfully assembled into a seamless, consistent theoretical construct. Instead Huli employ the notions of attachment and detachment according to their individual assessment of self-interest at any given moment (1992:248–9).

The *epo atene* at Porgera are pursuing the same course. As long as they are able to take up residence in Porgera, in accordance with the related (though not identical) Engan, Porgeran, and Huli principles of group membership, and as long as Porgera is seen as an economically attractive venue, when compared to other parts of the highlands, then these people will continue to pursue the strategy of settling in Porgera.

As the mining company is well aware, the 'outsider' issue is complex and not amenable to a simple solution. Individual Porgerans must to a large degree accept responsibility for the influx of migrants within the valley. Not only have individuals allowed *epo atene* to reside in their areas, but many must have actively recruited people to the SML in the hope of gaining a greater compensation package (see

Table 5.8 Differences in economic status by residency type, 1993

	Porgerans	<i>Epo atene</i>	Visitors
Income and expenditure survey sample size	125	49	46
Mean fortnightly income (kina)	142.66	215.50	150.34
Diet survey sample size	224	116	30
Proportion with PJV employment (%)	13	7	-
Proportion with a business (%)	13	19	33
Average number of gardens	2.9	1.3	0.6

Source: Porgera survey data.

Table 5.9 Food eaten in the previous 24 hours by residency type, 1993 (per cent)

Food type	Porgerans	<i>Epo atene</i>	Visitors
Tinned fish	25	45	73
Rice	28	55	74
<i>Kaukau</i> (own garden)	83	63	35
Taro (own garden)	21	8	2

Source: Porgera diet survey.

Table 5.10 Percentage of non-Porgerans by community, 1993

Community	Non-Porgerans (%)
Anawe	65
Apalaka	17
Kulapi	68
Mungalep	15
Paiam	40
Porgera Station	71
Tipinini	4
Yarik	21
Mean	40

Source: Porgera diet survey.

Figure 5.1 Length of residence of non-Porgerans in Porgera, 1993
(n=140)

Source: Porgera diet survey

Burton 1991:40). A majority (three to one) of Porgerans, both inside and outside the SML, who commented on this issue, when we interviewed them at the end of 1992, expressed favourable opinions of their *epo atene*, who were seen to provide additional security to the households and communities with whom they resided. Porgerans were unwilling to use the law to overcome the lack of customary means for removal of unwanted kinsfolk, and their most common response to the question of why they could not get rid of the *epo atene* was one which cited the risk of security problems further down the Enga Highway.

Within the SML, the PJV had successfully worked with landowners to remove 'outsiders' from communities such as Kulapi. Outside the SML, there was no direct way that the company could do anything about the problem, though offers were made to provide landowners with advice on procedures for evicting unwanted *epo atene*. Company spending in other parts of Enga Province under the Tax Credit Scheme

has partly been intended to reduce the motivation for people in these areas to leave home and travel to Porgera. However, until the level of government services and economic development in other parts of Enga and the Southern Highlands is improved, individuals will continue to see Porgera as the place for a new and better life, to which a cognatic descent system gives many of them access.

Conclusions

Porgera is an area where the physical environment has always limited the productivity of the subsistence agricultural system. In the past, this has been compensated for by the low population density, allowing a low intensity of use. Most of the studies carried out prior to mine development considered that these factors would mean a minimal impact of the mine on the agricultural system. The system could be intensified, and previously untouched areas, such as the zone between 2,400 m and 2,700 m, could be used to compensate for any loss of gardens associated with mine development. Greater amounts of cash were likely to bring a switch away from a dependence on garden foods to a diet based on store-bought foods. Severe problems were only thought likely to occur for small groups of people most affected by loss of land.

After three years of mine operation, several factors had combined to make some of these predictions obsolete. The massive in-migration of *epo atene* and other 'outsiders' had stressed the subsistence base of the Porgerans in areas within and around the SML. Greater use of higher altitude gardens (above 2,400 m) was limited by environmental constraints. Perhaps most significantly, the relatively inequitable distribution of compensation payments meant that the bulk of the population were still dependent on the subsistence sector for their basic food requirements. In absolute value, the contribution of the subsistence sector to the Porgeran economy had probably more than doubled between 1987 and 1993 as a result of local inflation and the greater population resident in the valley.

In the two areas studied in detail, Apalaka and Kulapi, the subsistence system appeared to be under increasing stress. At Apalaka, there was very little room for expansion of the area under cultivation, and additional pressure was about to be placed on the existing gardening land by the loss of up to 15 hectares associated with the failing waste dump in the Anjolek. The Pulumaini people at Kulapi faced a somewhat different problem, in that they were being

compelled to construct gardens at high altitudes on poor soils, and the subsequent low yields were forcing them to depend on tradestore goods to a greater extent than other communities in the SML. Based on the evidence it does not seem reasonable to expect cultivation in Kulapi to extend up to 2,700 m. Although the cultivation zone had extended up to 2,700 m in some other parts of the valley (outside the SML), the poor soils and drainage, and the low sunshine hours, seem to have made this impracticable at Kulapi.

Notes

- 1 This survey was undertaken by Ben Imbun and five students from the University of Papua New Guinea.
- 2 Porgera escaped the effects of frosts which hit other parts of the highlands in 1981 (Wohlt *et al.* 1981).
- 3 Meggitt (1957) had previously described the system as reverting to fallow after the second crop.
- 4 Population per square kilometre of potentially useful land (i.e. land below 2800 m which is not too steep or too swampy to be gardened).
- 5 Compensation payments, one particular aspect of the cash economy, had another impact on the gardening system at Porgera. It was not uncommon practice for gardens to be planted, and houses built, by people in anticipation of compensation payments being made by the company when the area was needed for mine development. This was documented by Pacific Agribusiness (1987) and Jackson (1991), and was still occurring in 1993. However, such incidents did not represent the real role of gardens for the bulk of the Porgeran population, as reflected in the results of the diet survey.
- 6 The definitions in the two surveys varied. In the income and expenditure survey, respondents were asked whether they were born in Porgera, and whether they usually lived in Porgera. I defined the *epo atene* as those not born in Porgera, but now living there, and 'visitors' were those born outside Porgera who did not usually live there. The diet survey again asked if the respondent was born in Porgera, but also asked how long the respondent had been in Porgera, and whose house the respondent stayed in last night, rather than whether the respondent usually lived in Porgera. In this case, I defined the *epo atene* as those not born in Porgera, who had been at Porgera for over six months, or had stayed the night before in their own house, or in the house of a parent or husband.
- 7 It is worth noting that responses to this question could have been affected by people wanting to assert their perceived right to be in

Porgera by overstating their period of residence, or by older people, in particular, citing the first time they had visited Porgera, rather than the time when they had taken up residence.

- 8 Previous surveys found between 17 per cent (household survey, November 1992) and 43 per cent non-Porgerans (income and expenditure survey, December 1992). The variations probably reflect the difference between the targeted populations (see Chapter 3). A figure of around 40 per cent non-Porgeran residents in the valley is probably realistic, if somewhat conservative.