

AO655
AN INVESTIGATION OF PESTICIDE AND MICROBIAL
INTERACTIONS ON COFFEE AS A MEANS OF
DEVELOPING AN IPM STRATEGY FOR
ECONOMICALLY IMPORTANT COFFEE PESTS IN
SMALLHOLDER FARMING SYSTEMS IN MALAWI

Socio-Economic Report on Initial Survey of Smallholder
Coffee Growers in Northern Malawi

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EXECUTIVE SUMMARY

Smallholder coffee production in Malawi has declined in the last few years due mainly to the cessation of the Smallholder Coffee Authority (SCA) managed credit scheme which has affected the ability of growers to purchase the required agricultural inputs for efficient coffee production. The changes in the SCA, a government sponsored parastatal, are related to the economic problems facing Malawi which have had a negative impact on both tax revenues and government expenditure thereby reducing the funding for credit schemes in general. Pressure to implement a more market driven economy in Malawi, and reduce the power of government monopolies, has also been applied by external bodies and donors. Against these negative developments, market liberalisation has allowed the entry of private coffee buyers, which has combined with recent improvements in world market prices and contributed to an increase in farm-gate prices. Despite this, the lack of capital or access to credit has forced the majority of growers to adopt a relatively low input system, resulting in generally poor yields with the majority of households producing less than 100 kg of green beans per annum. This has led to Malawi becoming one of the most inefficient smallholder producers in Africa¹. The situation would appear unlikely to change in the near future and alternative strategies for efficient and sustainable coffee production need to be sought.

Coffee is an important export crop for Malawi, ranking 4th as an export earner. Though smallholder production currently accounts for only 3 per cent of national production, it is a central element of the livelihood strategies of those communities which cultivate it in the Northern Region, providing them with their only significant source of cash income. The recent liberalisation of the domestic marketing system, which has improved the prices growers receive as well as the timeliness of payments, has engendered a more positive feeling about the future of coffee for these small-holder growers.

Despite the recent setbacks and the financial inability of most smallholders to purchase the required agricultural inputs, they have not abandoned their coffee. There are a number of reasons for this but the principal one is that they have no real alternatives for generating cash income and the high value to weight ratio of coffee makes it an ideal crop for this relatively remote region. Growers have, wherever possible, turned to low cost (but very labour-intensive) disease and insect pest control strategies, but the efficacy of these is limited and the incidence of these problems has increased markedly; new low-cost alternatives need to be found.

The results in this report highlight the importance of coffee in the rural communities of northern Malawi, the recent changes that have occurred in the system and smallholder's desire to continue with the production of the crop. Economic analysis also indicates that coffee should remain an important element of the farming system, but that there are key production and marketing issues which need to be addressed if coffee cultivation is to be successful in this sector. These include:

- reducing the economic impact of coffee plant diseases and insect pests under the smallholder low input/output system
- development of a new sustainable credit system
- creating an enabling environment for the effective development of a competitive domestic marketing system including access to rural pulperies (wet factories) for private buyers.

¹ Conversely the estates in S. Malawi are amongst the most efficient coffee producers globally, ranking fifth among the 23 countries surveyed (LMC, 1997).

Whilst this project is principally concerned with the first issue, as the others fall outside its direct remit, they remain important for the successful uptake of the project's scientific outputs.

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1.0 INTRODUCTION

1.1 Project Outline

1. The principal purpose of this RNRRS CPP funded project (A0655) is to improve coffee yields in smallholder farming systems in Malawi by devising an economically viable, and locally acceptable means of controlling important insect pests and diseases. Local agencies have identified coffee berry disease and stem-borers as major production constraints, and these are the major focus for project activities.
2. The project is aiming to fulfil indicative output HS204 of the RNRRS strategy *improved methods developed for the management of priority pests of arabica coffee, banana, plantain and fruit trees*.
3. The project consists of four major activities: (1) socio-economic and diagnostic surveys of smallholder coffee growers in all major production areas; (2) on-station experimental trials (studies) at the Ministry of Agriculture's research station at Mzuzu and on sectional plots owned by the Smallholder Coffee Authority in Mzuzu and Nkhata Bay Highlands; (3) on-farm participatory trials on medium-sized estates and smallholder plots in Mzuzu and Nkhata Bay Highlands; (4) laboratory studies at Mzuzu and Mkondezi research stations in Malawi, and at the Natural Resources Institute, International Mycological Institute and University of Kent in the UK.

1.2 Role of Socio-Economics in the Project

4. This report is concerned with the collation and analysis of data in activity (1) outlined in paragraph 3 above. The analysis will be used to inform the three subsequent activities also outlined in paragraph 3. It is intended that the report will be updated at various points during the three years of the project and will provide the basis of the socio-economic content of the final technical report to ODA.
5. The report consists of the analysis of field results in four main areas: (1) general livelihood and farming systems information; (2) agronomic factors; (3) pest and disease situation; (4) harvesting practices and marketing system. The first two sections will consider the historical background to smallholder coffee production in Malawi and methodological issues relating to this initial survey.
6. The essential outputs of this project are scientific; the role of the socio-economic component is to inform the scientific component of the project rather than lead it. Most socio-economic inputs to projects of this nature are concerned with providing the economic and social context of the production system and ensuring the economic feasibility and social acceptability of any forthcoming interventions; this project is no exception.
7. This project is concerned with devising an IPM programme in which several approaches e.g. limited fungicide application, cultural control and sanitation practices, manipulation of natural bio-control agents, interplanting susceptible lines with resistant host materials are combined to give a more integrated control strategy. This requires research into the economics of pesticide application, the population dynamics of the microflora on coffee, and the efficacy of those different technologies under the conditions experienced by smallholders in Malawi. This report will attempt to draw out the implications of the results of this initial survey with regard to each of these approaches.

2.0 SMALLHOLDER COFFEE PRODUCTION IN MALAWI

2.1 History and Institutions

8. Coffee is a major smallholder crop in many eastern and southern African countries. In Malawi arabica coffee represents the fourth largest export crop, and in 1995 nearly 4300 smallholder farmers¹ were registered in the Northern Region, producing 4-500 tons per annum or 2-3 per cent of total national production (SCA, 1995). It has been regarded as an important crop for smallholders since it was introduced into the Northern Region in the 1950s². Although representing a relatively small proportion of total production, smallholder coffee is generally regarded as being of a superior quality³ to that produced by the large-scale plantations in the southern part of the country, and commands a good market price in general⁴. It is also an essential part of the livelihood structure of the households cultivating it in northern Malawi, since the high value to weight ratio of coffee makes it an ideal (perhaps, even the only worthwhile) cash crop for these very remote areas. In these areas it is generally the most important cash crop and farmers perceive it to be a fundamental component of their livelihood strategies (see section 4.1).

9. The principal smallholder growing areas in northern Malawi are Misuku Hills, Phoka Hills, Viphya North, Nkharta Bay Highlands and South East Mzimba. All are characterised by high altitude (in excess of 1200 metres above sea level (masl)) and high rainfall (more than 1000 mm per annum).

10. In the early days of cultivation growers used to sell their coffee through co-operatives to buyers based in Moshi, Tanzania. Soon after independence, with increasing government intervention in the economy, these co-operative societies were de-registered⁵ and smallholders were forced to sell to government established monopolistic buying companies. The first of these was the Farmer's Marketing Board (later to become ADMARC) followed by the Smallholder Coffee Authority (SCA) which was given total control over the coffee sub-sector. The SCA was formed in 1971 under the "Special Crops Act" with the mission to promote and foster the commercial development of coffee production by smallholders in the Northern Region and. SCA covers all aspects of coffee production being the sole provider of inputs, credit and extension and the monopoly purchaser of ripe cherries and mbuni⁶ from farmers. The SCA still owns and operates all the pulperies (wet factories) and transports inputs and processed coffee; in addition it processes parchment and markets green coffee and more recently roasted, milled and packed coffee for the domestic market.

11. The performance of the SCA has recently been placed under the spotlight, and concerns have been expressed over increasingly late payments to growers, poor producer prices, their

¹ Information taken from Small holder Coffee Authority records in 1995. However, this probably represents an over estimation since, in many cases, more than one grower registered per household (see 2.3). In addition the number of growers has declined since 1995 as the market became less attractive.

² Though there was more limited cultivation by smallholders probably as far back as the late 1940s.

³ This is probably related to the widespread and centralised/monitored practice of sun-drying in the smallholder sector as opposed to mechanical drying techniques used in the plantation sector.

⁴ Malawian smallholder coffee sells at a good premium on the international markets as do most arabicas; however it is not regarded as a single origin coffee and is blended with other origins (i.e. not sold as Malawian coffee). Overfield (1996) and LMC International (1997) provide further information on this area

⁵ It is not clear why the government de-registered the co-operatives. One school of thought argues that this was because of financial mismanagement, while another that the previous government was concerned about the role of co-operatives were playing in the economic, social and political life of the country.

⁶ This is coffee which is allowed to dry whole after picking, or dries on the coffee bush, and then is hulled after further drying.

high costs and inability to scale down operations as smallholder production has fallen⁷. It is important to note that the SCA has faced a number of problems beyond its control including conflicting missions (e.g. commercial development versus social marketing functions) and poor roads and communication infrastructure.

12. This situation has altered somewhat during the last two years with liberalisation of the domestic marketing system leading to increased competition. SCA is no longer the monopsonistic buyer : with two significant other private buyers now in the domestic market; the competition has improved the prices being offered to growers⁸. The future structure for coffee institutions providing marketing services and input delivery systems is currently under debate in light of the points raised in paragraph 11. The SCA was due to be disbanded by the end of the last financial year (March 1997); although exactly what was to follow was far from clear.

2.2 Production System and Social Relations of Production

13. Coffee in this system is cultivated on land held under customary tenure generally utilising family labour. There is a low incidence of the use of hired labour (both casual and permanent). However many households have reciprocal labour exchange 'agreements' with other households.

14. In many households both husbands and wives are registered growers, with separate plots. Field investigations revealed that the major reason for this was to increase access to the SCA credit scheme for inputs which was only available to registered growers⁹. However, in practice the plots were almost always jointly cultivated and the gender division of labour appeared to be very similar in plots managed by men or women. Except in very rare cases (for example in female headed households) the more technical areas of coffee production (often defined as requiring tools and/or chemicals) e.g. spraying and pruning, are regarded as a male preserve. Other practices such as mulching are dominated by women, whereas planting and harvesting seem to be more mixed activities (see section 4.3 for more detailed discussion).

15. Under the direction of the SCA extension agents, smallholders have instituted a fairly high input production system with extensive use of purchased agro-chemicals. This system was completely dependent upon the credit scheme that was run by the SCA and as this collapsed so did the use of inputs. This has been compounded by late payments to growers in recent years, and particularly this season where growers have not received any payments as yet¹⁰, which has effectively prevented those few growers still willing to use purchased inputs from doing so. The credit scheme also provided for the individual and group purchase of knapsack sprayers and other equipment; SCA also supplying the equipment and spare parts. Most farmers still have some access to these productive assets through either individual or group ownership or some form of reciprocal exchange (see section 4.4 for further discussion of this). However, as the SCA has come under increasing financial pressure, the physical supply of machines and spare parts has declined as has access to credit. This has had a

⁷ This goes beyond the scope of this project but has been covered by a number of reports; these include Bailey (1995 and 1996), Price Waterhouse (1995), Deloitte and Touche (1991) and Shone (1990).

⁸ Fieldwork results would suggest that this was in the region of 20 per cent (excluding any movements in the international market).

⁹ Credit and inputs under this scheme were accessed per registered grower rather than a per household basis.

¹⁰ Growers are suppose to receive two-thirds of final prices by the end of September with the remainder due by the end of December. As of February 1997 they had received any payment.

significant impact on pest and disease populations as farmers have adjusted their management strategies.

2.3 Brief Overview of Pest and Disease Situation

16. Stem-borers and coffee berry disease (CBD) are two very important production constraints within smallholder farming systems and were the ones most commonly reported by farmers (see section 6.0 for more details). The former have become more of a problem since the withdrawal of insecticides such as Aldrin and Dieldrin (see section 6.4). These compounds were administered as a stem paint, which provided a more cost effective means of treating bushes than the spray applications now recommended. CBD, caused by the fungal pathogen *Colletotrichum kahawae*, has increasingly become a problem, spreading downwards from Kenya and Tanzania into northern Malawi and thence to the plantations in the southern region during the last decade. Yield losses of up to 60 per cent have been reported in severe cases.

17. The two coffee varieties predominantly cultivated by smallholders, Geisha and Agaro, are both susceptible to CBD¹¹, and although more resistant cultivars have been identified i.e. Catimor 129, it is likely that smallholders will only replace their current stocks of this perennial crop relatively slowly, if at all, depending on their perceptions about future economic returns from coffee and concerns about individual cultivars. Fungicide applications are expensive, and the use of protectant, e.g. copper based, compounds are often ineffective during the rainy season. The introduction of systemic compounds has been delayed due to concern about build up of pathogen resistance and possible adverse effects on flavour. Insect pest and disease problems will be covered in more detail in section 6.0 of this report.

2.4 Costs of Production and Economic Returns

18. Estimates of production costs and economic returns were commissioned by this project (to LMC International) due to the lack of reliable information available within Malawi. The SCA does have some figures but these are based on their own yield and input targets rather than what is actually happening in farmers' fields. The LMC International figures, are based on trade estimates and their own in-country files which are more realistic. A brief summary of their findings is presented here; a more detailed account is available in their report (LMC International, 1997).

19. Using standard cost estimation procedures¹² LMC came to the following conclusions. Smallholders in Malawi have very low yields compared to other African producers, making Malawi smallholders one of the highest cost arabica producers and with production costs of US\$1971 per tonne in 1994/95 (LMC International, 1997). Indeed, of the 23 arabica producing countries surveyed, Malawi was the 16th most expensive, with total costs 7% above the world average and 35 per cent above the African average. Maintenance costs, including labour, fertiliser and chemical inputs, capital and administration, are the most important cost component of the production cycle, accounting for 56% of total costs, although the production costs for all activities (including hulling and grading, harvesting and

¹¹ Agaro is more susceptible to CBD. Cultivars Geisha and Agaro were originally introduced to Malawi because they were resistant to bark disease caused by *Fusarium stilboides*.

¹² Using an engineering approach. Involves establishing a number of 'technical blueprints' for differing production technologies. Long-term economic costs associated with coffee trees were discounted (i.e. NPV calculated) using real interest rates of 5% per annum.

processing and establishment) are high compared with other African countries. Smallholder labour costs (when valued at minimum wage levels) are relatively low and accounted for only 50% of total production costs in 1994/95, compared with a world-wide proportion of 62% of total costs. Plantations in Malawi are much more competitive, having much lower overall costs at US\$1528 per tonne of green beans (17% under the world average, and ranking 5th out of the 23 countries surveyed) despite the high level of fertiliser and chemical application. In this case production costs are off-set by increased productivity, and maintenance costs minimised by mechanisation (LMC International, 1997).

20. Despite improved producer prices in 1994/95 (due to increased international prices) smallholders were only able to cover variable costs and not their total costs of production (assuming labour is valued at the minimum wage rate). Smallholders continue to grow coffee despite this situation and must therefore value their labour at a lower rate than the minimum wage. This is probably because the minimum wage rate does not reflect the opportunity cost of their time, most likely due to the restricted employment opportunities in the rural areas in which they reside (see section 4.1 for more detail).

21. Smallholder coffee production in Malawi is a marginal economic activity, in part due to low yields (which result in high unit costs) and in part due to the low prices received by growers. There is no incentive for farmers to involve themselves in activities which raise yields unless the price they receive improves (LMC International, 1997). Prices received by growers have increased recently due to global price improvements and increasing competition from buyers in the domestic market. However, a concurrent reduction in the supply of credit and inputs has made it difficult for them to capitalise on this situation. Further action is therefore required on this. In addition, domestic marketing costs need to be reduced (reform of SCA or other institutional arrangements) and by increasing the export unit value (possibly by more specialist niche export marketing - see section 7.0).

2.5 Conclusion

22. It is clear that smallholder coffee production in Malawi is a marginal economic activity due to low yields and low producer prices. These issues are related, and it is likely that improved farm gate prices would provide an incentive for growers to increase production by cultivating larger areas and improving their management regime. This project is directly trying to address the former by trying to develop low cost technologies for pest and disease control particularly focusing on the most important problem for smallholders - that of Coffee Berry Disease (CBD). Many other factors which influence the success of the sub-sector go beyond the scope (and control) of this project. With increasing returns to growers, the incentives for uptake of new technologies is higher and so now is a good time to develop and introduce new production methods; their low cost nature should assist in their uptake in the medium and long-term. It is important to note that very few alternative cash crops are available to these groups of farmers and there is a substantial demand for any low cost pest and disease control measures that can be developed.

3.0 METHODOLOGY

3.1 Purpose of Fieldwork and Survey Areas

23. The fieldwork on which this report is based had two objectives: (1) to conduct a broad socio-economic survey using individual grower semi-structured interviews to provide background information for the project on general structure of the rural economy, coffee agronomy, the general pest and disease situation and marketing issues; and (2) to conduct a diagnostic (disease and pest) survey of randomly selected coffee gardens. These two objectives were integrated into a single field visit, with two members of the survey team conducting the farmer interviews and the other two the diagnostic pest and disease survey concurrently for the same farmer.

24. All five major smallholder coffee growing areas (Misuku Hills, Phoka Hills, Viphya North, Nkhata Bay Highlands and South East Mzimba) were visited and a total of 40 growers were interviewed. In each case their principal coffee garden¹ was also assessed for pests and diseases. The amount of time spent in each area was approximately proportionate to its relative importance in terms of total smallholder production. Table 3.1 below summarises the relative importance of the areas and the number of growers surveyed in each. There are some minor discrepancies between relative importance of areas and the number of growers surveyed (much of which can be explained by logistical problems during the survey) but in general it is a reasonable reflection of the geographic spread of farmers.

Table 3.1 The relative importance of the five main smallholder coffee production areas^a and number of growers surveyed during the present study

Area	Total Number of Growers	% of Total Smallholder Production	Number of Growers Surveyed	% of Total Surveyed
Misuku Hills	2146	50.1	16	40
Phoka Hills	947	22.1	8	20
Viphya Hills	432	10.1	2	5
South East Mzimba	502	11.7	9	22
Nkhata Bay Highlands	255	5.9	5	12
Total	4282	100	40	100

^a Figures are based on data from SCA registered growers list which includes all smallholder producers (some households have more than one registered grower)

¹ Some farmers have more than one coffee plot and time constraints meant that only one could be visited. In these cases only the farmer's main coffee plot was surveyed.

3.2 Sampling Approach

25. Sampling was conducted using a semi-structured (random) hierarchical approach based on the SCA list of registered smallholder growers which was used as the sampling frame. The SCA list has a complete listing of all smallholder growers in Malawi divided by areas and community. The number of farmers surveyed in each area was decided by the relative importance (in terms of grower numbers) of the area. A two-stage semi-structured selection of farmers was made; first the community or village was randomly selected and then a number of growers were randomly selected from that location.

26. Although the sampling frame provided by the SCA was a few years old, and there were a few minor discrepancies, it was found to be fundamentally accurate. This can probably be attributed to the fact that growers had to be registered both to sell their coffee and gain access to credit. In a few of the households selected, the registered grower had died; in these cases the inheritor of the coffee enterprise was generally assessed or, where this was not possible, their nearest neighbour.

27. Although farmers were not stratified with respect to economic and social criteria, and it is therefore not possible to know if all relevant groups of growers were represented, the approach taken ensured that the farmer selection process was not biased by extension agent preferences, proximity to main roads and principal marketing points (pulperies and small town centres).

4.0 FIELD RESULTS 1: LIVELIHOOD AND MARKETING SYSTEMS

4.1 Livelihood Structure and Farming System Changes

28. The forty farmers interviewed were asked to list all the crops they grew and then rank their top three in order of importance. Table 4.1 summarises the crop list and indicates that the three most commonly grown crops in the coffee-based farming systems of northern Malawi surveyed were coffee, maize and beans followed by cassava, bananas and millet (although as only registered coffee growers were interviewed, the crop list has, by definition, a strong bias toward coffee). Table 4.2 reflects this pattern, and shows that farmers considered maize, coffee and beans to most important followed by cassava, bananas and millet. Some households mentioned other cash crops such as tobacco, and vegetables such as onions, which may indicate a local market for these products at that location.

Table 4.1 Frequency of all crops grown by the forty farmers interviewed

Crop	Number of times mentioned	% of all farmers
Coffee	40	100
Maize	35	88
Beans	34	85
Bananas	28	70
Cassava	18	45
Millet	14	35
Sweet Potatoes	9	23
Potatoes	8	20
Groundnuts	5	13
Vegetables	4	10
Citrus	4	10
Sugar Cane	3	8
Onions	3	8
Pineapple	3	8
Tobacco	2	5
Soybean	1	3

Table 4.2 Relative importance of the three highest ranking crops^a

Crop	Number of times mentioned	% of all farmers
Maize	30	75
Coffee	29	73
Beans	28	70
Cassava	10	25
Bananas	9	23
Millet	5	13
Sweet Potatoes	3	8
Groundnuts	1	3
Vegetables	1	3
Onions	1	3
Tobacco	1	3
Potatoes	1	3

^a Figures in this table relate to the top three ranking crops only and are based on farmer's perceptions collected during field interviews. Information based on 40 interviews.

29. The prominence of coffee in the general livelihood system is confirmed by the results in tables 4.3 and 4.4. Of those farmers who were interviewed, 70 per cent ranked coffee in their three most important crops (overall, not just as a source of cash) because it is generally the most important source of cash income for households in these areas. This is confirmed by the results in table 4.4, which shows that very few households have any other significant sources of non-agricultural cash income. The only other significant cash generating activity mentioned by the surveyed households was animal sales. However, these only yield small amounts of money and are more of an emergency fall-back mechanism (and store of wealth) than a regular source of cash income. It can therefore be concluded that coffee has a major role in the livelihood system as the principle source of cash income.

Table 4.3 Farmer's perceptions of the relative importance of coffee in the farming system^a (Overall Ranking)

Rank	Number of Farmers	% of all farmers
1	22	55
2	4	10
3	2	5
4	8	20
5	1	3
6	3	8
Total	40	100

^a These figures relate to the general importance of coffee in the overall farming system rather than just as a source of cash income.

Table 4.4 Frequency of Income Sources other than Coffee in the Farming System

Source of Income	Number of Households	% of all Households
None	25	63
Occasional Animal Sales	7	18
Salary/Pension	3	8
Beer Brewing	2	5
Trade Store	2	5
Carpentry	1	3
Milk Sales	1	3
Remittances*	1	3
Animal Trading**	1	3

* Income given to the household, most frequently, by relatives formally employed in urban areas.

** Animal trading relates to a larger scale activity than occasional animal sales and forms a permanent and regular source of income.

30. General questions about changes in the farming system, focusing on the last 10 years, were raised during the survey and the results are summarised in table 4.5. The two major issues arising were a decline in the importance of coffee as a source of income¹, and an increase in the overall importance of food crops such as maize and beans particularly as a source of income through local markets.

¹ Though coffee was still ranked as the most important crop in the farming system by 55 per-cent of the farmer's surveyed implying it had an even greater status in the past.

31. The decline in importance of coffee as a source of income would at first appear to contradict the results presented earlier in this section (Tables 4.1, 4.2) which suggest that coffee is still the most important source of income. Relatively speaking this is still the case, but absolute incomes have fallen. This can be attributed to two reasons: (1) credit availability for agricultural inputs has declined dramatically in the last four years, reducing yields; (2) coffee prices received by growers have fallen in real terms and payments have become increasingly delayed. Yields have fallen due to increased disease and insect pest associated losses (see section 6), lowered fertiliser application rates (see section 5), and lower rates of yield-increasing investment.

32. To a limited extent, households have tried to offset the decline in coffee incomes by growing more food for both local markets and home consumption (to offset the cash requirement for purchase of food from local markets). The efficacy of this strategy is limited because it is dependent on levels of local income which are in turn largely determined by the levels of externally derived cash flows² such as coffee or tobacco. Unless other cash sources³ are identified, which are independent of the purchasing power of the local rural community, the amount of produce sold will be limited by the small circulation of income. Coffee, with its high weight to value ratio, is an ideal crop for these remote areas in northern Malawi and very little else is available to these growers at the present time. The small alterations they have made to their livelihood system with recent declines in coffee cannot offset those losses in terms of income generation.

Table 4.5 Household Perceptions of Farming System Changes*

Nature of Change Mentioned	Number of households giving this response	% of total responses
Decline in importance of coffee	18	32
Increase in overall importance of food crops	7	12
Increase in importance of food crops as a source of income	7	12
General decline in crop productivity (yields)	5	9
None	4	7
Increasing production for market sales	3	5
Decline in credit for and physical supply of farm inputs	3	5
Increase in importance of coffee	2	4
Total (all responses not just those in table)	57	100

* Only those changes mentioned by more than one household were included in this table.

² Where an income source is not dependent on the aggregate (total) income of the local rural community, such as coffee. How much coffee growers can sell is not determined by the aggregate income level of their community, but rather by the demand levels from consumers in other countries, providing an independent injection of income into the community.

³ This would include proximity to an employer or other external externally derived economic activity.

4.2 Scale and Organisation of Smallholder Coffee Production

33. Tables 4.6, 4.7 and 4.8 indicate that coffee production for the majority of households in the small-holder sub-sector is small; nearly 80 per cent of the households surveyed were producing less than 100 kg (green bean equivalent) of coffee per year. Thus despite the fact that coffee is, for the majority of households, the most important source of income levels remain low and 80 per cent of households receive less than US\$100 per year from coffee cultivation. That amounts to an average (from the data collected by this survey) of just over \$US11 per capita once household size has been incorporated into the estimates. It is clear that this project is concerned with predominantly very resource-poor communities who suffer a correspondingly higher impact of insect pests and diseases because yields are so low.

Table 4.6 Production Classes (Scale) of Smallholder Coffee Production (GBE - Kgs)

Production Class (kgs)	Number of Households	% of households
< 20	11	28
21 - 50	10	25
51 - 100	10	25
101 - 200	5	13
> 200	4	10
Average = 92	40	100

Most of the data represented in this table was authenticated by SCA grower records (coffee passbooks that the growers hold) wherever possible rather than verbal recall alone. The same applies to tables 4.7 and 4.8.

Table 4.7 Income Classes of Smallholder Producers (US \$)

Income Class (\$US)	Number of Households	% of Households
< 20	15	38
21 - 50	6	15
51 - 100	11	28
101 - 200	5	13
> 200	3	8
Average = \$81.31	40	100

Incomes were calculated by multiplying household production estimates by the average US\$ producer price derived from LMC International (1997) for the 1994/5 season. The SCA has held producer prices constant (in Malawi Kwacha) since then despite the devaluation of the currency, although the effect of foreign exchange rate changes this (i.e. an increase in producer Kwacha prices) has not been passed to growers.

Table 4.8 Per Capita Coffee Incomes (US \$)

Income Class (\$US)	Number of Households	% of Households
< 5	25	63
6 - 10	6	15
11 - 20	3	8
21 - 40	3	8
> 40	3	8
Average = \$11.07	40	100

34. The households surveyed had a number of different structures with the single nucleated farm (with a male household head) predominating, though in many cases the wife had registered with the SCA as a separate enterprise in order to gain additional credit and inputs. The reasons for this were outlined in section 2 of this report, and all are essentially run as joint household enterprises with similar decision-making systems, distribution of work activities, and distribution of cash proceeds. In the case of polygamous households it is a little more complicated; all wives were separately registered with the husband making some, but not all, production decisions related to their coffee (he was always in sole control of his own registered plots). Coffee income streams were more often more under women's control in polygamous households than in other household structures; they really represent multiple households but many aspects of coffee production are integrated (and hence their definition as households). In female-headed households, the women would sometimes ask a male neighbour or relative to assist with traditionally "male" tasks such as pruning or spraying.

Table 4.9 Family Structures of Surveyed Households

Family Structure	Number of Households	% of Households
Single, nucleated (no separate grower registration)	24	60
Single, nucleated (separate grower registration)	9	23
Polygamous	6	15
Divorced, female-headed	1	3
Widowed, female-headed	1	3

35. General discussions were held with farmers on the problems they face with coffee production. These were separated into three categories: (1) agronomy, which will be dealt with in section 5.0;(2) crop protection (see section 6.0); and (3) general. The more general problems related to labour shortages and the findings are summarised in table 4.10. Discussions focused on which particular activities were most labour-intensive or required additional labour revealed that the two major areas of concern (activity) were harvesting and weeding, both of which are very labour intensive. Table 4.11 highlights ways in which households try to manage these labour constraints and indicates that the majority do not actually have any system for dealing with this. A handful of (wealthier) households hire extra labour, and a few have reciprocal exchange relations with other households. The labour-intensive nature of the present coffee production system is clearly perceived by farmers to be a constraining factor.

Table 4.10 Labour Shortages in Coffee Production

Activity for which Labour Shortages Occurred	Number of Households	% of all households
Harvesting	26	65
Weeding	24	60
Digging planting holes	3	8
Mulching	2	5
Pruning	1	3
None mentioned	4	10

Table 4.11 Strategy for managing labour shortages

Approach	Number of households	% of all households
None (no strategy for management)	29	73
Hire Labour	6	15
Reciprocal Arrangements with other Households	5	13

4.3 Market Access and Form of Sale

36. The majority of households are located within 5km of the nearest rural pulper (SCA owned, wet factory) and SCA figures indicate that the majority of growers have relatively close access (< 5 km) to these factories (see also table 4.12). This is a result of substantial investment by SCA in the past on behalf of growers. The effect of the availability of pulperies has been to encourage sales in the form of cherry rather than parchment. Indeed, prior to 1995/6 smallholders were required by law to sell cherry to the SCA pulperies. However since 1995/6 private buyers (of which there are two large buyers) have been encouraged to buy from smallholders and this has altered the form of sale a little. Results from the survey (relating to last season 1996/7) indicate that parchment sales accounted for 25 per cent of all sales and cherry most of the rest (with residual amounts of *mbuni*).

37. This change occurred because, in the first instance, the new private buyers were not allowed to use the rural pulperies and were unable to transport the bulk of cherry (transport costs are high and some of the growing areas very remote) and were therefore having to buy the predominantly home-processed parchment. This led to some quality problems, as the cherry was often processed using a mortar and pestle damaging the parchment, and an agreement was reached for this season (1997/8) to give the private buyers access to the pulperies. It is likely this will lead to a decline in sales of parchment.

Table 4.12 Distance to Nearest Selling Point of Surveyed Households

Distance	Number of Households	% of all households
< 2 km	14	35
2 - 5 km	20	50
5 - 10 km	4	10
> 10 km	2	5

4.4 Liberalisation and Attitudes to Private Buyers

38. The liberalisation of domestic marketing has led to increased buying competition. Private buyers have been offering growers prices about 20 per cent higher than those set by the SCA, but still less than half of the growers surveyed on this study were selling to the new buyers. There are a number of reasons for this which are highlighted in table 4.14. The most significant appear to be: (1) mistrust (related to the fact they are new and that the SCA is well known); (2) growers are unaware of their presence (private buyers have yet to penetrate all growing areas); or (3) private buyers refused to buy the home-processed parchment (usually related to poor quality). These problems will probably disappear with time as private growers expand in number and coverage, farmers get to know them, and the new buyers gain access to the rural pulperies. Conversely, the reasons people are selling to the private buyers (though several were selling to both private and SCA buyers) are related to higher prices and immediate payment⁴.

Table 4.13 Proportion of Surveyed Growers Selling to Private Buyers

	Yes	No
Number of Households	17	23
% of all Surveyed Households	23	58

Table 4.14 Reasons given by the farmers interviewed in the survey why they did not sell their coffee to the private buyers last season (1995/6)

	Number of Households	% of Households
Lack of Trust	9	23
Not aware of private buyers	4	10
Buyers refuse home processed parchment	4	10
Selling too small volumes for private traders	2	5
Crop arrived too late for buyers	2	5
Loyalty to SCA	1	3
Still making repayments to SCA credit scheme	1	3
Have not sold any coffee in the last two years	1	3
Perception of lower prices (due to co-operatives taking their cut)	1	1

⁴ SCA does not pay immediately but in three tranches. These payments have been getting increasingly late.

Table 4.15 Reason's given for selling to the private buyers

	Number of Households	% of Surveyed Households
Offering higher prices than SCA	12	30
Were paying immediately with cash	10	25

4.5 Conclusion

39. Coffee is a central component of the livelihood strategy for this group of farmers and the principal source of cash to these resource-poor communities. Even though smallholder coffee has gone into something of a decline (due to poor producer prices, late payments, lack of credit and physical supply of farm inputs) it still remains a very important crop well suited to the growing conditions of northern Malawi and its high value to weight ratio makes it ideal for this relatively remote region. The liberalisation of the domestic market has halted some of this decline, bringing better prices to farmers for immediate cash payment however, credit and supply of farm inputs remain a problem for which free market solutions are unlikely to be effective alone.

40. Within the context of these livelihood and marketing systems, this project is attempting to develop low cost solutions to specific crop protection problems which themselves have had an increasing impact as reduced credit availability and supply of inputs has lowered yields. The resource-poor nature of these communities mean that free-market replacement of the services once provided by SCA is unlikely to occur; crop protection issues are unlikely to be addressed effectively by farmers unless they face positive incentives and the appropriate supporting institutional structures are in place. Particular concerns are: (1) provision of credit; (2) physical supply of inputs, and (3) ensuring adequate buying competition (including effective access to pulperies for private buyers) so that the share of final export value growers receive is maximised. Whatever final decision is made for the institutional structure⁵ of the smallholder coffee industry, it must address these three concerns.

⁵ A two-tier co-operative system (as opposed to the status quo and a full free market solution) was favoured by the consultant brought in to review the institutional structure of the smallholder industry (Bailey, 1996) for the Government of Malawi. No final decision has yet been made.

5.0 FIELD RESULTS II: AGRONOMY

5.1 Varietal Ranking and Perceived Characteristics

41. Farmers were asked which coffee varieties they grow (Table 5.1) , and which they perceive to perform the best (Table 5.2). The results in tables 5.1 and 5.2 indicate that farmers are growing a relatively small number of varieties (with most growing two or three different varieties) with Geisha, Agaro and Local¹ dominating. Geisha and Agaro were promoted heavily by the SCA to combat Fusarium Bark Disease, caused by the fungal pathogen *Fusarium stilboides*, and these have since become dominant. Farmers perceive Geisha (80% of those surveyed) as the best variety currently available.

Table 5.1 A list of the coffee varieties grown by the forty households visited during the survey

Variety	Number of Households	% of Households
Geisha	38	95
Agaro	27	68
Local	16	40
Caturra	11	28
Dale Mix (1)	3	8
Total	95	100

(1) For explanation of origins of this variety - see footnote² below

Table 5.2 The most favoured variety (i.e. ranked number 1) grown by the forty households visited during the survey

Variety	Number of households ranking this first	% of total households
Geisha	32	80
Local	6	15
Agaro	1	3
Caturra	1	3
Total	40	100

¹ "Local" refers to any variety whose name growers do not know. For example, some of the varieties referred to as local were clearly Mundo Novo. The term does not therefore represent a specific type or variety.

² "Dale Mix" is probably a variety introduced fairly early on and may also be called local. It probably arrived in Malawi before the 1950s and may have been one of those virtually wiped out by Fusarium Bark Disease to be replaced with Geisha and Agaro.

42. Table 5.3 summarises the reasons farmers gave for growing Geisha, the variety they regard as performing best. It is principally favoured because it is high yielding, followed by its tolerance to major coffee diseases³. Other reasons given for growing Geisha include the fact that it was the only variety available at the time of planting as SCA, who had the monopoly for seed supply, promoted this variety very heavily. The reasons for growing other varieties are summarised in appendix 1.

Table 5.3 The positive and negative attributes of Geisha cited by the thirty eight farmers interviewed during the survey who grew this variety

Characteristic	Number of times mentioned	As % of all farmers growing Geisha
High yielding	30	79
Disease tolerant/resistant	14	37
Stable yield	5	13
Early maturing	3	8
Only variety available at the time of planting	3	8
Susceptible to overbearing	3	8
Die-back		
Requires a lot of fertiliser	1	3
Total	59	100 (=38 farmers)

5.2 Fertility Management

43. Discussions concerning fertility management revealed that fertiliser was widely used in coffee cultivation and, traditionally, over 90 per cent of households applied commercially bought fertiliser (see appendix 2 for a list of fertilisers used). However, this practise has declined dramatically in the last 4 years reaching a trough last year. This situation is summarised in table 5.4 which highlights the present situation whereby 75 per cent of the farmers surveyed had stopped using fertiliser in the last 4 years. The reasons for this are related to the removal of credit facilities by the SCA, and in the last two years, late payment for the previous season's coffee and lack of availability. Of the twenty five per cent of farmers who had not changed their level of usage the majority were larger farmers or households with other significant income flows who were less credit dependent.

³ Fusarium Bark Disease almost wiped out the coffee industry in Malawi during the 1950s; Geisha and Agaro were introduced to combat it. They are however, susceptible to Coffee Berry Disease.

Table 5.4 Changes in fertiliser application rates on coffee by the forty households included in the survey

Change in fertiliser use during 4 year period up to present	Number of farmers	% of farmers
Completely stopped	30	75
Reduced but still using some	1	3
Have not changed usage	9	23
Total	40	100

44. The only other significant fertility management activity is mulching⁴ and three-quarters of the households surveyed said they followed this practise⁵. Since the mulch usually comprises home grown materials such as maize stover or banana leaves it is not credit or cash dependent and so has not been affected by external factors in the last few years.

5.3 Other Agronomic Practices

45. Other areas of agronomic management have not changed drastically mainly because they are not so heavily cash or credit dependent. These areas include weeding, pruning, shading and intercropping practices.

46. Virtually all households regularly weed their coffee (see table 5.5) with the majority of farmers weeding 2 or 3 times per year⁶. This pattern has not changed for most households, with only 2 suggesting that they were now weeding less as they were generally discouraged from growing the crop due to increasingly late payments (by the SCA) for their coffee.

Table 5.5 The frequency of coffee garden weeding by the forty households included in the survey

Number of weedings per annum	Number of farmers in this category	% of all farmers
None	1	3
1	2	5
2	10	25
3	17	43
4	5	13
5	2	5
Total	40	100

⁴ Using material such as banana skins and old leaves.

⁵ Although the diagnostic pest and disease survey suggested this was in reality lower at about 50 per cent; see appendix 3 for a summary of these results

⁶ This was generally confirmed by the pest and disease survey ; see appendix 3

47. Pruning activities have also remained fairly unchanged and with the exception of one household all the smallholders interviewed were following the standard SCA recommendations⁷. Coffee is often intercropped with bananas, and newly established coffee can be inter-cropped with maize and/or beans during the first two years of growth. However, the only permanent widespread intercrop is bananas which is also often used as a wind break around the edge of the coffee garden. They also provide effective shade for young coffee. Another popular shade tree was *Grevillea* and nearly half of the farmers surveyed were using these or other species of tree (SCA recommended the practice and supplied the seedlings). Of the thirteen farmers who were not using any shade most had been growing *Grevillea* but these had died for a variety of reasons. Many of these growers complained that they could not now purchase the seeds or seedlings from the SCA to replace them.

5.4 Conclusion

48. Agronomic management of smallholder coffee has altered significantly during the last few years in Malawi in response to institutional changes within the SCA which have affected provision of credit, input and extension services. However, the SCA extension service remains active and farmers generally still seem to be following recommended practices where they can afford to. The removal of the SCA managed credit scheme and the increasingly late payment for coffee have dramatically affected the use of all purchased inputs including fertiliser. The only factor working against this is the increase in number of private buyers who offer improved farm-gate prices and, more importantly in terms of cash flow, immediate payment. Growers remain active and have by no means abandoned their coffee, but have had to alter their management strategies to cope with the new situation. This has had the greatest impact on fertiliser usage.

⁷ Again this was confirmed by the pest and disease survey. The recommended pruning practise is to cap the bush at 2 metres tall, which encourages growth of shoots which are then removed in a process called handling. This can be done several times a year and helps open up the bush for ease of spraying etc. Pruning also takes place (SCA recommended) at the end of the season and involves removing dead branches, interlocking branches and branches growing inwards.

6.0 FIELD RESULTS III: DISEASE AND INSECT PESTS

6.1 Farmer Identified Disease and Insect Pest Problems

49. Detailed discussions concerning disease and insect pest problems were held with the farmers in this survey and the results are summarised in tables 6.1 and 6.2. There are six commonly mentioned problems: stem borers, green scale insect, coffee leaf rust, coffee berry disease, leaf miner and *Antestia* bug. When farmers were asked to rank these problems a clear pattern emerged (in order of importance): stem borer, coffee berry disease (CBD), green scale, coffee leaf rust, tip borer and leaf miner. In both cases stem borers were identified as the problem giving greatest concern followed by coffee berry disease, green scale, coffee leaf rust and leaf miner (all ranked fairly close together). These coincided with the results from the pest and disease survey conducted at the same time¹.

Table 6.1 A summary of the insect pest and disease problems cited by the 40 farmers interviewed in the survey.

Problem	Number of times each pest/disease was mentioned	% of total number of households
Stem borer	36	90
Green Scale	22	55
Coffee leaf rust	21	53
Coffee berry disease	16	40
Leaf miner	16	40
<i>Antestia</i> bug	9	23
Tip borer	3	8
Stinging caterpillars	3	8
<i>Fusarium</i> bark disease	3	8
Leaf spot	3	8
Coffee berry borer	2	5
Berry moth	1	3
Termites	1	3
Aphids	1	3
Total	137	100

Table 6.2 Farmer's ranking of insect pest and disease problems

Problem	Number of times ranked first	% of all households
1. Stem borers	24	60
2. CBD	5	13
3. Green scale	4	10
4. Coffee leaf rust	4	10
5. Tip borer	1	3
6. Leaf miner	1	3
Total	39	100

¹ Though at this time it was not possible to derive the incidence of coffee berry disease as it was too early in the season to see the development of the lesions. Also the entomological data from this survey is incomplete due to the entomologist (technician) being taken ill during the course of the survey. See also results of a later entomological survey (Kapeya and Msiska, 1997)

6.2 Changes in Disease and Insect Pest Control Strategies

50. The problems identified in section 6.1 require different forms of control² both chemical and physical. The cessation of the SCA-managed credit scheme, late payments to growers and availability problems have influenced the control measures farmers have decided or been able to follow. These together have led to a dramatic decline in the use of chemical control methods (the commonly used control methods are summarised in appendix 4) which is highlighted by the results presented in tables 6.3 and 6.4. As a result although farmers perceived that these problems were becoming worse, they simply could not afford to do anything to control them.

Table 6.3 Changes in farmers' practises for managing stem borer and green scale insects over the last 4 years (based on the sample of 40 farmers)

Change in control method	Stem Borers		Green Scale	
	Number of Farmers	% of all those with stem borers	Number of farmers	% of all those with green scale
From chemical to physical treatments ^a	24	67	-	-
From chemical to no treatment	3	8	14	64
From commercial chemical to traditional treatments ^b	-	-	2	9
No change	9	25	6	27
Total	36	100	22	100

^a This involves moving from stem paint application of chemicals, principally Aldrin or Dieldrin (which are now banned) to physically poking a small piece of wire through the borer holes to kill the larvae. This is an effective, though labour-intensive, strategy used by the majority of households experiencing this problem.

^b This involves moving from application of commercially released chemicals (principally Fenitrothion) to local chemical mixtures (e.g. using fishbeans and other locally available ingredients) and also a soap solution. These appear to provide a limited form of short-term control and few farmers practise this.

² Stem borers though 'traditionally' controlled with a stem paint (Dieldrin or Aldrin - these are now banned) can also be dealt with physically with a small piece of wire to kill them whilst in the stem. This is effective though very labour intensive and tedious and is one of the recommended physical control strategies in different countries including Kenya.

Problems like CBD and Leaf Rust in most cases only require chemical control in areas where disease severity warrants spraying.

Chemical control for Fusarium Bark Disease is only recommended as a wound sealant after pruning, handling or seating.

Leafspot is only controlled with chemical sprays when outbreaks are severe. In most cases spraying with copper-based fungicide is restricted to the nursery.

Antestia, Green Scale, Stinging Caterpillar, Aphids and Termites are not normally controlled with chemicals because it is not economic, in most cases, to do so. Tip borers can, in addition to chemicals, be controlled physically with a piece of wire to kill them as for stem borers.

Leaf miners, in most cases require chemical control.

The following pesticides were given on credit to control the following:

- Chlorotharonyl (Daconil) for CBD
- Cupic hydroxide for CBD and Leaf Rust
- Anvil for Leaf Rust
- Fenitrothion for most insects including leaf miner. Offers very little control for stem borer larvae
- Karate for insects generally

Table 6.4 Changes in farmers' management practises for Coffee Berry Disease (CBD) and coffee leaf rust over the last 4 years

Change in control method	Coffee Berry Disease		Coffee Leaf Rust	
	Number of farmers in each category	% of all those with coffee berry disease	Number of farmers in each category	% of all those with coffee leaf rust
From application of chemicals to no control method	10	63	18	86
No change	6	37	3	14
Total	16	100	21	100

6.3 Conclusion

51. Crop protection strategies for smallholder coffee growers have altered radically as the availability of credit has declined, payments for coffee have been delayed and previously effective compounds have lost efficacy (due to build up of pest/pathogen resistance) or unavailable. In many instances such chemical measures³ have been replaced with labour-intensive physical control (where this is possible and effective) or no control strategy at all. Despite the relatively high price of coffee on the world market, changes are not filtering down-wards to the growers, the majority of whom originate from resource-poor communities with limited or no access to credit. Furthermore, at the present time, it seems unlikely that any major new credit scheme is likely to replace the system set up by the SCA. However, growers continue to maintain their coffee (although not to the same level of management as before the recent changes) and it is still considered a crop suitable for their environment and relative remoteness. Under these circumstances any low cost disease and pest control measures developed by this project would be highly beneficial to these communities.

³ It is important to note that farmers generally have a very poor understanding of chemical action which is highlighted by the indiscriminate use of copper oxychloride for virtually everything. More detail is contained on this issue in appendix 4.

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Appendix 1 - Varietal Characteristics

Farmer's perceptions of, and the reasons why they grow, particular varieties are summarised in the four tables below (with the exception of Geisha which was covered in section 5.1.).

Table 1.1 Farmer's perceptions of the positive and negative attributes of Agaro (based on the information provided by the 27 farmers growing this variety)

Characteristics	Number of times mentioned	% of all farmers growing Agaro
<i>Negative</i>		
Low yielding	13	48
Susceptible to disease (CBD)	13	48
Variable yield	7	26
Large fertiliser inputs required	5	19
Late maturing	1	4
<i>Positive</i>		
The only variety available at time of planting	2	7
Disease resistant (<i>Fusarium</i> bark disease)	1	4
Total	42	100 (=27 farmers)

Although Agaro is not held in as high regard by farmers as Geisha; and farmer's perceptions, particularly of the negative characteristics, were relative to Geisha it was still grown by 27 of the 40 farmers surveyed.

Table 1.2 Farmer's perceptions of the positive and negative attributes of "Local"¹ (based on the information provided by the 16 farmers growing this variety)

Characteristic	Number of times mentioned	% of all households growing local
<i>Negative</i>		
Low yielding	4	25
Variable yields	2	13
Too tall	1	6
<i>Indeterminate</i>		
Late maturing	2	13
Reasonable yields	1	6
<i>Positive</i>		
Hardy	4	25
Stable yields	1	6
Disease tolerant/resistant	8	50
Total	23	100 (=16 farmers)

¹ Local refers to any variety whose name growers do not know. For example, some of the varieties referred to as local are Mundo Novo. It therefore does not represent a variety as such.

Table 1.3 Farmer's perceptions of the positive and negative attributes of Caturra (based on the information provided by the 11 farmers growing this variety)

Characteristic	Number of times mentioned	% of all farmers growing Caturra
<i>Negative</i>		
Disease susceptible	4	36
Fertiliser dependent	4	36
<i>Positive</i>		
High yielding	5	45
Only variety available at the time of planting	1	9
Late maturing	1	9
Total	15	100 (= 11 farmers)

Table 1.4 Farmer's perceptions of the positive and negative attributes of Dale Mix² (based on the information provided by the 3 farmers growing this variety)

Characteristic	Number of times mentioned	% of all farmers growing Dale Mix
<i>Positive</i>		
Disease tolerant	1	33
High yield	1	33
Uniform ripening	1	33
<i>Indeterminate</i>		
Reasonable yield	1	33
Total	4	100 (=3 farmers)

² Dale Mix is probably one of the early varieties which may also be called local. These probably arrived in Malawi before the 1950s and may have been one of those virtually wiped out by *Fusarium* Bark Disease to be replaced with Geisha and Agaro.

Appendix 2 - Fertilisers Used by Households

Many households were using more than one fertiliser, often using Di Ammonium Phosphate (DAP) as a top dressing and Calcium Ammonium Nitrate (CAN) as a base.

Table 2.1 The type of fertiliser used on coffee by the forty households included in the survey

Fertiliser Type	Number of farmers using	% of all farmers surveyed
CAN (Calcium Ammonium Nitrate)	32	80
DAP (Di Ammonium Phosphate)	27	68
Manure (goat, chicken, cattle and pig)	17	43
23;21: 0 + 45 (NPK + 45)	4	10
Urea	2	5
SoA (Sulphate of Ammonia)	1	3
Total	83	100

Appendix 3 - Summary of Insect Pest and Disease Survey Results

Insect pest and disease survey data was collected during 2 survey trips. The first survey comprised an assessment of CBD on the principal coffee garden of each household visited during the farmer interviews in February 1997. A second survey was conducted in May 1997 by DAR scientists from Mkondezi and Lunyangwa Research Stations (Kapeya and Msiska, 1997). This focused entirely on insect pests and diseases and the information gathered is summarised in Tables 3.1-3.5.

Table 3.1. A summary of the disease data collected during the first diagnostic survey in February 1997 (including: tree health and management - weeding, mulching, pruning, green health and overall score (1-3); mean CBD incidence and severity).

Sample no	General tree health and management					CBD incidence and severity	
	Weeding	Mulching	Pruning	Green health	Score (1-3)	no. nodes with CBD	mean severity
1	Y	N	N	Y	2	0	0
2	N	N	N	N	1	0	0
3	N	N	N	N	1	0	0
4	N	N	N	N	1	0	0
5	Y	N	Y	Y	1	0	0
6	Y	N	N	Y	2	0	0
7	Y	N	N	Y	2	0.1	0.1
8	Y	N	N	Y	3	0	0
9	Y	N	N	Y	2	0	0
10	Y	Y	Y	Y	3	0	0
11	N	Y	N	Y	2	0	0
12	Y	N	N	Y	2	0	0
13	Y	Y	Y	Y	3	0	0
14	Y	N	Y	Y	2	0.1	0.1
15	N	N	N	N	1	0	0
16	Y	N	N	Y	2	0.1	0.1
17	N	Y	Y	Y	3	0	0
18	N	N	N	N	1	0	0
19	N	N	N	Y	1	0	0
20	N	N	N	N	1	0	0
21	N	Y	Y	Y	2	0	0
22	N	N	N	Y	1	0	0
23	Y	Y	Y	Y	3	0	0
24	Y	Y	N	Y	3	0	0
25	Y	Y	Y	Y	3	0	0
26	Y	Y	Y	Y	3	0	0
27	Y	N	Y	Y	2	0	0
28	Y	Y	Y	Y	3	0	0
29	Y	Y	N	Y	2	0	0
30	Y	N	N	N	1	0	0
31	Y	N	N	Y	2	0	0
32	N	N	N	N	1	0	0
33	N	N	Y	Y	2	0	0
34	Y	Y	Y	Y	3	0	0
35	Y	N	N	Y	2	0	0
36	Y	N	N	Y	2	0	0
37	Y	N	N	Y	2	0	0
38	Y	N	N	N	1	0	0
39	Y	Y	Y	Y	2	0	0
40	Y	N	N	Y	3	0	0

The data indicate that in February levels of CBD were generally low, with disease only reported on farms 7,14,16. Much higher levels of CBD were reported during the second survey conducted in May 1997. Unfortunately at the time of going to press detailed figures by farm (a total of 25 for the disease survey; 13 for the entomological survey) were not available and will be published as a separate file note for interested readers.

This second survey was conducted by pathologists and entomologists from DAR. This survey focused on two important coffee growing areas, the Misuku Hills and Rumphu Divisions. Farmer's fields were randomly selected in four areas: Katowo Chisi and Sokola in Misuku Hills, and Salawe and Junju areas of Rumphu.

At each farm insect pest assessments were made on 5 randomly selected trees (irrespective of age). Assessments were made as follows. In the first instance flying insects in the canopy, including adult leaf miners, were identified and counted. Then a black polythene sheet was placed under the tree which was vigorously shaken to release arthropods and spiders which could then be counted on the sheet. Finally the bush was closely inspected for pests such as leaf miner (*Leucoptera spp.*), green scales (*Coccus spp.*), mealybugs (*Planococcus spp.*) *Antestia* bugs etc. Potential natural enemies were also observed and noted.

The results are presented in tables 3.2 - 3.4.

Table 3.2: A summary of all insect pests recorded on randomly selected coffee gardens in the two coffee growing Divisions: Misuku Hills (I), Rumphu (II). In each case the data represent a mean score for five bushes.

Farm no.	Pest incidence data (mean of five plants)									
	Leaf miner	White borer	Yellow borer	Antestia	Berry moth	CBB (%)	Green scales	Mealy bug	Skeletonizer	Aphids
<i>Misuku Hills</i>										
1	0.4	0	0	0	0	0	0.8	0	0.2	0
2	0.8	0	0	0.2	0	0	0.4	0	0.2	0
3	0.8	0.8	0	0	0.2	2	0.8	0.2	0	0
4	1.2	0	0.2	0.2	3	0	1.4	0.2	0	0
5	0.8	0	0	0	0	0	0	0.4	0	0.4
6	1.0	1.6	0.4	0	0	7.2	0.8	0.2	0	0.2
7	0	0.4	0	0	0	0	1.2	0.2	0.2	0.2
8	1.8	0.2	0	0.2	0	0	0.8	0	0	0
9	2.0	0.6	0.2	0.2	0	0	0.8	0	0	0
10	1.2	0	0	0	1	2	0	0.02	0	0
Mean	1.0	0.2	0.1	0.1	1.5	2.7	0.7	0.1	0.1	0.1
<i>Rumphu</i>										
1	1	0.2	0	0	0.2	0	0	0	0.8	0
2	2.4	0	0	0	0.2	0	0	0	0.2	0
3	1.0	0	0	0	0	0	0	0	0.4	0
Mean	1.5	0.1	0	0	0.8	0	0	0	0.5	0

These data indicate that, whilst a diverse range of insect pests occur on coffee in the Misuku Hills, there are fewer in Rumphu district where only leaf miner, white borer, berry moth and skeletonizer were observed (although as relatively few farms were sampled this can only be considered to be an indication). The incidence levels presented in Table 3.2 indicate that the major insect pests in the region are leaf miners, green scales and mealy bugs. However, in

terms of economic damage, the stem borers are also very important. This is because, although the mean infestation level (across all sites) was only 40%, the larvae cause serious damage which can result in tree death. Thus even 1 or 2 larvae may have an economic impact.

Further analysis was done to determine whether the incidence of the major pests varied among cultivars. The farmers visited were growing Agaro, Geisha and "local". In Table 3.3 the data from Table 3.2 have been expressed as a mean percent incidence for each cultivar. This was done to adjust for the different numbers of bushes assessed for each cultivar, and it should also be noted that values have been incorporated for both sites.

The results indicate that overall more pests were recorded on "local" varieties than either of the two improved cultivars. With respect to individual pest species there was some variation within this general pattern, thus local was most attacked by green scales, CBB, mealy bug, skeletonizer and aphids; but was relatively little attacked by the white or yellow borers. Geisha was most infested with leaf miner and both white and yellow borer. Agaro was generally the least attacked by insect pests; although was equal to "local" with respect to leaf miner, and Geisha with respect to berry moth, green scales, mealy bug, skeletonizer and aphids.

The natural enemies discovered during the survey are summarised for the two divisions in Table 3.4. These data show that the predominant groups were the spiders, followed by ladybirds.

Table 3.3: A summary of the potentially "beneficial" insects observed on coffee during the survey in Misuku Hills and Rumphi Divisions in May 1997.

Locality	Total numbers of "beneficial" insects in each division						
	Lady bird	Spiders	Hover fly	Lace Wings	Rove Beetles	Praying mantis	Predator y ants
Misuku Hills	8	112	3	1	2	3	3
Rumphi	4	31	1	0	0	0	0
Total	12	143	4	1	2	3	3

Although preliminary, this data provides a useful indication of the distribution of potentially beneficial insects. Additional studies should therefore seek to provide a more quantitative measure of such insect groups in relation to specific insect pests, and determine the conditions (e.g. variety, shading, pruning, inter-cropping) which most favour them.

Table 3.4: A summary of the incidence of the major coffee pests on three cultivars: Agaro, Geisha and “local” growing on 13 farmer’s fields in the Misuku Hills and Rumphi Divisions of N. Malawi

Coffee cv	mean percent infestation by each pest											
	No. bushes	Leaf miner	White borer	Yellow borer	Antestia	Berry moth	CBB	Green scales	Mealy bug	Skeletonizer	Aphids	Overall for cultivar
Agaro	20	60	5	5	0	10	0	25	5	5	5	16.4
Geisha	36	86	19	30	8	11	6	22	8	8	8	22
Local	7	57	2.7	0	14	0	29	72	29	29	29	32
mean		67.7	8.9	11.7	7.3	7.3	11.6	39.7	14	14	9.7	

Appendix 4 - Common Control Strategies for Major Crop Protection Problems

The figures in this appendix relate to how major crop protection problems have been controlled in the past, rather than the changes that have occurred in the last 3-4 years relating to reduced credit availability and liquidity in the rural economy.

Table 4.1 A summary of the methods used for stem borer control by the 36 coffee growers interviewed during the survey who had stem borers on their coffee

Control measure	Number of farmers	% of all growers with stem borer problems
Aldrin	21	58
Fenitrothion	10	28
Physical (killing larvae in the tree by poking with a wire)	5	14
Karate	1	3
DDT	1	3
Physical (uproot and burn tree)	1	3
No control	1	3
Total	40	100 (n=36)

NB: some farmers were using more than one control method

Table 4.2 A summary of the methods used for green scale insect control by the 22 coffee growers interviewed during the survey who had this insect on their coffee

Control measure	Number of farmers	% of all growers with green scale
Fenitrothion	14	64
Copper Oxychloride	4	18
No control	2	9
Aldrin	1	5
Paraffin	1	5
Total	22	100 (n=22)

Table 4.3 A summary of the methods used for control of Coffee Berry Disease (CBD) by the 16 coffee growers interviewed during the survey who had this disease on their coffee

Control measure	Number of farmers	as % of all with CBD
Copper Oxychloride	9	56
Nothing	4	25
Fenitrothion	2	13
Anvil	1	6
Daconil	1	6
Physical: remove and burn infected berries	1	6
Bravo (bought from Tanzania)	1	6
Total	19	100 (n=16)

NB: some farmers had been using more than one control method

Table 4.4 A summary of the methods used for control of Coffee Leaf Rust by the 21 coffee growers interviewed during the survey who had this disease on their coffee

Control measure	Number of farmers	as % of all those with CLR
Copper Oxychloride	17	81
Kocide	3	14
Daconil	2	10
Aldrin	2	10
Fenitrothion	2	10
Nothing	2	10
Anvil	1	5
Total	29	100 (n=21)

NB: some farmers were using more than one control method

Table 4.5 A summary of the methods used for control of leaf miner by the 16 coffee growers interviewed during the survey who had this insect pest on their coffee

Control measure	Number of farmers	as % of all those with leaf miner
Fenitrothion	10	63
Copper Oxychloride	3	19
Physical (squeezing the leaf)	1	6
No control	2	13
Total	16	100 (n=16)

NB: These were the usual ways to control leaf miner before the recent changes to the SCA. Following the reduction/removal of chemical control 10 out of the original 16 farmers were now practising no control at all. The remainder had not changed their practices (but this latter group included two who were not previously using any control).

Information on the chemicals used by the farmers interviewed during the survey is presented in Table 4.6.

Table 4.6: The characteristics of the chemicals applied by coffee growers for control of insect pests and diseases on their coffee (information presented covers: trade name, manufacturer, class, active ingredient and target organism).

Trade name	Manufacturer	Class	Active ingredient	Target
Aldrin	Shell Agrochemicals (compound banned May 1989 in UK)	persistent organochlorine insecticide	aldrine	broad spectrum insecticide
Anvil	ICI Agrochemicals (= Zeneca)	SDI conazole fungicide	hexaconazole	broad spectrum fungicide
Cuprokylt	Unicrop	copper based protectant fungicide	copper oxychloride	<i>Phytophthora infestans</i> , <i>Pseudoperonospora humuli</i>
Daconil Bravo	Tripart Farm Chemicals	chlorophenyl fungicide	chlorothalonil	broad spectrum fungicide
Supracide combi Ultracide Combi	Ciba Geigy (discontinued)	persistent organochlorine insecticide	DDT	broad spectrum insecticide
Dicofen Novathion Sumithion Sumicidin	Sumimoto Chemical Co.	organophosphorus insecticide	fenitrothion	broad spectrum insecticide
Karate	ICI Agrochemicals (= Zeneca)	pyrethroid insecticide	lambda cy-halothrin	<i>Lepidoptera</i> <i>Coleoptera</i> <i>Hemiptera</i>
Kocide	Kennecott Corp. Griffin Corp (present)	protectant copper fungicide and bactericide	copper hydroxide	<i>Peronosporaceae</i> <i>Alternaria spp.</i> <i>Phytophthora spp.</i> <i>Mycosphaerella</i> <i>Leptosphaeria spp.</i>