<u>PROJECT R8204 [Part 2]</u>
APPENDIX 1: Working Paper A1063/1

Crop protection implications for coffee smallholders in Malawi of the introduction of Catimor cultivars.

R. J. Hillocks, N. Phiri and C.S.M. Chanika

Introduction

Coffee [*Coffea arabica*] has been cultivated by smallholders on the hillsides of northern Malawi for most of the last century. Around 5000 households depend on coffee for their livelihood in five areas with suitable soils and climate, centred around the town of Mzuzu. The main area of coffee production in Malawi is in the south of the country, centred around Mount Mulanje, where the crop is grown on large estates. Production in the north is on a small scale and yields are among the lowest in the world, but the quality is high. The good quality of 'Mzuzu' , coffee potentially opens the access to 'fair trade' markets if production can be increased to meet the minimum volumes required to secure contracts with 'fair trade' companies (Hillocks, 2000; 2001).

Until recently, the main varieties grown in northern Malawi were 'Agaro' and 'Geisha' introduced in the 1960/70s to replace the local cultivars grown by smallholders that were susceptible to *Fusarium* bark disease [*Gibberella stilboides*]. In the early part of the 1990s, due to a combination of poor producer prices and disputes with the then Smallholder Coffee Authority [SCA], many farmers neglected their trees and the smallholder sector went into decline (Hillocks *et al*., 1999). Between 1997 and 2002, the European Union supported a programme of rehabilitation of the smallholder coffee sector. Primary processing plants were devolved, coming under the control of local farmers groups. Institutional reform resulted in the SCA becoming the Smallholder Coffee Farmers Trust [SCFT], which was more responsive to farmers needs. Support for the SCFT from the EU continues until 2005, and direct assistance to coffee smallholders has taken the form of financial support for the multiplication and distribution of seed and seedlings of cv. Catimor, originating from the estate sector. The programme also provides inputs on credit to farmers who plant 500 or more Catimor trees. By the end of 2004, around 5,000,000 seedlings had been planted in nurseries since 1999, and it is estimated that at least 2,500,000 seedlings have already been transplanted from the farmers nurseries to the fields. Despite the low world price for coffee in 2003/04, demand for the Catimor material is currently running at more than 1,000,000 a year [H. B. Kalua, pers. comm.]

Catimor culivars are now widely grown around the world but the original hybrids were developed for resistance to coffee leaf rust [CLR] (*Hemileia vastatrix*) in Colombia and at the Centre for Investigation of Coffee rust [CIFC] in Portugal (Rodriguez *et al*., 1975). A large number of crosses were made in Colombia during the 1970 and 1980s between Hybrido de Timor, a tall natural hybrid between *C. arabica* and *C. canephora*, and the dwarf types cv. Caturra and cv. Catuai. Selected seedlings were screened in Portugal against the complete collection of rust races held at CIFC. In the early 1990s a number of Catimor populations were brought to Malawi by the Coffee Research Unit of the Tea Research Foundation, for use in the estate sector. The EU programme of support to the coffee industry in Malawi provided the finance to supply seed and seedlings derived from five Catimor populations to the smallholder sector, through the SCFT. This was intended to contribute to rehabilitation of smallholder coffee by gradually replacing the aging population of Agaro and Geisha with the high yielding Catimors, which would also enable CLR to be controlled without the need for costly fungicide sprays.

Unlike the situation in Colombia, in addition to CLR, the coffee crop in Malawi is also affected by coffee berry disease [CBD] (*Colletotrichum kahawae*), that was first reported in the country in 1985 and is now found in all the higher-altitude coffee areas of the country (Phiri *et al*., 2001).

The most important insect pest in Malawi and some neighbouring countries, is the white stem borer [WSB] (*Monochamus leuconotus*) (Hillocks *et al*., 1999; Hillocks, 2000), which has been a destructive pest of coffee in Malawi and neighbouring African countries, since the middle of the last century. WSB was partly responsible for the demise of the early coffee industry in Malawi before the Second World War. When coffee cultivation was promoted again after the war, dieldrin applied as a stem paint provided effective control of WSB. By the 1990s the manufacture of dieldrin was terminated due to its high level of mammalian toxicity and long persistence in the environment. This has undoubtedly contributed to the resurgence of WSB as a major pest of arabica coffee in Malawi and elsewhere. Recognising the importance of WSB as a threat to the livelihoods of coffee growers in the region, a project on the biology and management of the pest, funded by the Common Fund for Commodities was initiated in 2002.

When the Catimor populations first arrived in Malawi, some seed was sent to Lunyangwa Research Station that has the mandate for coffee research appropriate to the smallholder sector. There they were screened for resistance to both CLR and CBD. Although the Catimor populations tested were resistant to the Malawian races of CLR and were generally susceptible to CBD, some seedlings from Catimor 129 showed resistance to CBD. Further selection for resistance to CBD was carried out at Lunyangwa [by N. Phiri] resulting in development of cv. Nyika. However, only small quantities of Catimor 129 were available for distribution to smallholders and resources were not available at the time to clonally propagate cv. Nyika. Steps are now being taken to establish a garden of cv.Nyika in isolation from other coffee trees, so that pure seed can be obtained in quantity. Responding to demand from farmers, more seed of Catimor 129 has been obtained for distribution to smallholders by the SCFT, from the Estate coffee sector in south of the country.

In view of the future dependence of the smallholder coffee sector in Malawi on Catimor cultivars, work was undertaken to screen some of the populations against CBD and WSB and to use the results to assess the likely crop protection implications.

Materials and methods

Eight coffee varieties/lines (see Table 1.) were evaluated in a Completely Randomised Block Design (RCBD) experiment with 4 replicates. Each plot had 24 coffee bushes. The coffee bushes were planted at a spacing of 3m between rows and 1.2m within rows. The evaluation for CBD was started when the coffee bushes were eight years old. The experiment was under rainfed conditions as is the case in smallholder coffee sector.

Table 1. Details of Catimor coffee entries:

Entry	Generation	Derivation
Catimor population 1	F5	Progeny of CIFC 7960
Catimor Population 2	F6	Progeny of CIFC 7961
Catimor Population e	F6	Progeny of CIFC 7962
Catimor Population 4	F6	Progeny of CIFC 7963
Catimor Population 5	F6	Progeny of CIFC 7958
12468/16	N/A	Caturra X Hybrido de Timor
Caturra – commercial variety		
Catimor 129 – commercial variety		

CIFC = Coffee Rust Research Institute [Portugal]

Catimor population 1 –5 and line number 12468/16 were brought from Portugal by the TRF, for screening for resistance to coffee leaf rust in Malawi. They were planted at Lunyangwa Research Station, through an EU funded project. Caturra and Catimor 129 are from South America and they were adopted as commercial varieties by the estate sector in Malawi. Catimor 129 came to Malawi through Kenya.

Fertilizer application

Fertilizers were applied as follows:

	Element and amount (kg/ha)		
Year	N	P_2O_5	K_2O
1	50	50	50
2	100	50	75
3	150	50	100
4+	200	60	150

Screening for resistance to coffee berry disease

Screening in the field
Two branches were tagged on each of the twenty-four coffee bush of each entry. Coffee berry disease data were collected from the tagged branches by counting total berries and berries infected by CBD, to obtain percent age CBD infection. The data were arcsine transformed and analysed with Mstat statistical package.

Screening for resistance in the laboratory
Coffee seedlings were inoculated with *Colletotrichum kahawae* spores as described by Van der Graaf (1981). Seeds from individual coffee bushes were sown, after

surface sterilisation with sodium hypochlorite (10%) in sterile sand in plastic seed trays and kept in a laboratory at room temperature. Watering was done daily. At soldier stage (about six weeks from sowing) seedlings were inoculated with a spore suspension of *Colletotrichum kahawae* by spraying with a hand sprayer. A spore suspension was prepared by flooding 7d. old cultures growing on Malt Extract Agar in glass Petri dishes, with sterile distilled water. The spore concentration was adjusted to 1×10^6 spores per ml with the aid of a haemocytometer. The trays were then incubated under high humidity conditions, in a growth cabinet set at 25±1 ˚C, with 90 ± 5 % RH, 12 / 12 hr day/night in a Fitotron growth cabinet Model 600 H (Sanyo Gallenkamp plc, UK). Lights levels of 25,000 lux were used provided by twelve 1.22 m x 40 watt warm white fluorescent tubes (Philips colour 29). After 14 days the plants were scored for CBD severity using a scale of 0 – 5 [see Table 1.].

<u>Assessment for resistance/susceptibility to stem borer infestation</u>

Five Catimors and the local cv.Geisha were planted in a randomised block design with 20 plants per plot, at two locations in northern Malawi in variety assessment trials. The plots were in close proximity to Geisha and Agaro coffee heavily infested with WSB. In their third year, these plants began to show signs of WSB attack and by their fourth year they were heavily attacked. The cultivars were assessed for their individual response to stem borer infestation by expressing the number of trees with entry or exit holes as a percentage of the stand.

<u>Yield assessment</u>

Data was collected from a net plot of 24 coffee bushes on cherry yield. Cherry yield was converted to clean coffee yield using a ratio of 6:1 (6 cherry : 1 clean coffee).

Results

<u>Response to CBD</u>

Coffee berry disease pressure was very high under field conditions as indicated by the level of disease on Caturra variety, a known susceptible variety. There were significant (P=0.01) differences in %CBD scores among the different entries (Table 2). All the Catimor populations were susceptible, but CBD was very slight in the field on cv. Nyika and no symptoms developed on the seedlings of this cv. in response to inoculation (Table 3).

<u>Response to WSB</u>

All the cultivars screened for their reaction to WSB were susceptible with no significant difference between cv. Geisha and the Catimors (Table 4).

<u>Yield</u>

There were significant (P = 0.001) differences in yield between the entries, with Catimor 129 (Nyika) giving the highest yield. 'Nyika' produced an average yield of more than 1 tonne per ha., which was about 5% higher than the average yield for the trial (Table 5).

Quality

Catimor 129 was superior to Caturra and as good as the best of the Catimor populations in terms of overall quality characters (Table 6) and has particularly good cup quality.

Discussion

Disease and pest resistance in Catimors
The Catimor populations derived from crosses between Hybrido de Timor and Caturra and selected for resistance to CLR (Rodriguez *et al*., 1975) that were tested in Malawi, were all susceptible to CBD. It is likely therefore, that where these populations have been distributed to smallholders, it may become necessary to spray fungicides for CBD control. Should this prove to be the case when the newly planted cultivars reach full bearing, it will diminish the benefit of not having to spray for CLR control. In the longer term, resources will be required to multiply and distribute cultivars with resistance to both CLR and CBD. Cv. Nyika would meet that need and seems to out-yield the Catimor populations under conditions at Lunyangwa, but it requires further agronomic evaluation under smallholder conditions.

Catimor 129 from which cv. Nykia was derived was found to be as susceptible as the Catimor populations to WSB, and none of the cultivars tested were significantly less susceptible to this pest than the current cv. Geisha. Widespread adoption of Catimor cultivars will therefore have little effect on the status of WSB as the main insect pest of arabica coffee in Malawi. It remains a priority for the coffee industry in the Region and for the smallholder sector in northern Malawi in particular, to find affordable control methods for WSB.

Integrated crop management for Catimors in Malawi
Catimor coffee cultivars are being distributed to smallholders in Malawi in order to improve the profitability of the crop. Although Catimors are potentially high yielding and are resistant to one of the main coffee diseases [CLR], they require careful management to produce high yield without overbearing. Furthermore, the practice of growing Catimors without shade, while maximising the yield potential, raises concerns about soil conservation and biodiversity. Added to this, there are pest management issues: WSB and CBD may yet threaten the rehabilitation of the smallholder coffee sector.

Catimors may need to be grown differently under smallholder conditions than under estate conditions. The previous generation of coffee cultivars grown by smallholders in Malawi, mainly 'Geisha' and 'Agaro' could be grown under low-input systems with shade trees or inter-cropped with banana. Catimors require comparatively heavy fertiliser application, all the more so when grown without shade. Much has been written about the impact on input use of the removal of subsidies under structural adjustment policies (e.g. Carr, 1997). If the smallholders who have adopted Catimors in Malawi are willing to apply the required quantities of fertiliser, it has to be available when and where it is needed, and, appropriate and accessible credit facilities must be in place. These are issues currently being addressed by the SCFT with financial assistance from the EU.

The planting system adopted may also be important to the success of the Catimors. They are usually grown without shade to benefit fully from their high yield potential. Spacing recommendations vary, but in one of the most intensive systems, the plants are grown at close spacing within the row so that the canopies of neighbouring plants quickly close to form a 'hedgerow'. To be fully effective, this system needs to be well fertilised and weeded. However, the overlapping canopy may be undesirable in areas where CBD is a problem, as the dense canopy maintains a humid micro-climate suitable for sporulation of *C. kahawae* and the overlapping branches facilitate the spread of the disease. A system where the Catimor bushes are grown at a spacing that avoids canopy overlap and which includes banana to provide a food crop and some shade, might be more sustainable in CBD-prone areas, particularly if fertiliser use is constrained.

CBD is beginning to appear on the Catimor populations already planted by smallholders at the beginning of the rehabilitation programme. This requires close monitoring and farmers should be made aware that fungicide sprays will be required should the disease appear. Copper fungicides can be used alone or as a tank mix with an organic fungicide among which, chlorothalonil has proved effective (Masaba and Opilo, 1990; Phiri, 2002).

If WSB damage is observed in a farmers coffee 'garden' or on nearby coffee trees, it would be advisable to use an insecticidal stem paint to treat the bottom 30 cm of the stem of unaffected trees. Insecticides such as fipronil and imidacloprid are proving effective against WSB in Malawi, but they are expensive, and less well-off smallholders will be reluctant to purchase them unless they can do so as part of a group. Well managed coffee that is properly fertilised and weeded may be less prone to attack by WSB, but is certainly better able to withstand invasion. If neighbouring fields are heavily infested, the trial reported in this paper has shown that little can be done to prevent the spread of WSB into adjascent fields, if insecticidal stem paint is not used. Where one or a few trees are affected in a vicinity, without a high insect pressure, the affected trees should be uprooted and burned before the adult beetle emerges to lay its eggs, which occurs with the first rains in October/November, two years after the initial invasion. Young trees can be killed within a year or so of attack, but older trees may tolerate attack. In larger trees where exit holes made by the beetles are accessible, an insecticide such as fenitrothion can be introduced into the hole in an attempt to kill any developing larvae in their tunnels. Wire spokes have also been used as a mechanical means of destroying the larvae (Hillocks *et al*., 1999). Bark-smoothing is practices by some smallholders as a way of discouraging egg laying by the WSB beetle. Smoothing the bark with a maize cob removes some of the crevices that are attractive egg-laying sites.

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References

Carr, S. J. (1997) A green revolution frustrated: lessons from the Malawi experience. *African Crop Science Journal* 5, 93 – 96.

Hillocks, R. J. (2001) Coffee: Is it still a viable cash crop for smallholders in Africa? *Outlook on Agriculture* 30, 205 - 212.

Hillocks, R. J. (2000) Integrated crop management for smallholder farmers in Africa with special reference to coffee in Malawi. *Pest Management Science* 56, 963 - 968.

Hillocks, R. J., Phiri, N. A. and Overfield, D. (1999) Coffee pest and disease management options for smallholders in Malawi. *Crop Protection* 18, 199 - 206.

Masaba, D. and Opilo, V. L. (1990) The performance of formulated mixtures of copper and organic fungicides against coffee berry disease, *Kenya Coffee* 55, 825 - 831.

Phiri, N. A. (2000) Status and Control of Coffee Berry Disease in Malawi. PhD Thesis, University of Kent, 270 pp.

Phiri, N. A., Hillocks, R. J. and Jeffries, P. (2001) Incidence and severity of coffee diseases in smallholder plantations in northern Malawi. *Crop Protection* 20, 325 – 332.

Rodrigues, C. J., Bettencourt, A. J. and Rijo, L. (1975) Races of the pathogen and resistance to coffee rust. *Annual Review of Phytopathology* 13, 49 - 70.

Van der Graff, N. A. (1981) Selection of arabica coffee types resistant to coffee berry disease in Ethiopia. *Mededilingen Landbouwhogeschool, Wageningen*, 110 pp.

Table 2. CBD Scoring system used for inoculated seedlings

Score	Description
0	No symptoms
1	From small greenish lesions to 1 or 2 narrow brown lesions. Lesions up to 0.5 mm wide
2	More than 2 brown lesions or brown coalescing lesions. Width of lesions exceeds 0.5 mm
3	Wide brown lesions with numerous black dots and/or black lesions. Black lesions may completely surround the stem but the top remains alive
4	Black lesion girdling the stem. Top killed

Table 3. Severity of CBD in Catimor cultivars compared to Caturra in field plots and on inoculated seedlings.

Cultivar	CBD Severity		
	% infected berries [season 1]	% infected berries [season 2]	seedling score* [score 0 - 4]
Catimor pop 1	47	57	2.0
Catimor pop 2	51	54	3.4
Catimor pop 3	55	44	2.1
Catimor pop 4	61	44	2.8
Catimor pop 5	64	52	-
Catimor 12468/16	16	45	-
Catimor [cv. Nyika]**	1	2	0
Caturra	47	43	3.0
LSD	25	13	-

*No ANOVA for seedling score as the number of seedlings screened of each cv. differed.
** 'Nyika' not included in the ANOVA
- , not included in the test

Table 4. Incidence of white stem borer damage on 5 Catimor cvs compared to a 'traditional' cultivar in northern Malawi.

Cultivar	WSB incidence at two sites			
	Nchenachena		Misuku	
	%	arcsin	%	arcsin
Cat 129	52	47.3	35	36.3
Cat 15077	72	59.2	35	35.8
Cat 15066	66	59.2	30	32.4
Cat 15069	62	51.1	42	40.1
Catimor 12468/16	57	49.6	35	36.2
Geisha	76	58.2	17	23.6
LSD		±28.8		±21.5

Table 5. Clean coffee yield from Catimor cultivars compared to Caturra, Lunyangwa.

Cultivar	Clean coffee yield [MT ha^{-1}]		
	Season 1	Season 2	Mean
Catimor pop 1	0.99	0.96	0.98
Catimor pop 2	1.02	1.22	1.12
Catimor pop 3	1.02	1.17	1.10
Catimor pop 4	0.95	0.95	0.95
Catimor pop 5	0.68	1.12	0.90
Catimor 12468/16	1.77	0.73	1.25
Catimor 129 [Nyika]	2.66	1.74	2.20
Caturra	0.83	0.88	0.86
LSD	0.32	0.50	

Table 6. Physical characters and liquoring quality of some of the coffee entries

Entry	Physical				Cup/Liquor					Total All characters
	Size	Colour	Defects	Total bean characters	Acidity	Flavour	Body	Total cup	Roast	
Cat. Pop. 1	2.8	3.0	2.8	8.6	1.5	1.8	1.3	4.6	2.8	16.0
Cat. Pop. 2	3.0	3.3	2.8	9.1	2.3	2.3	1.3	5.9	3.5	18.5
Cat. Pop. 3	3.3	4.5	3.0	10.3	2.5	2.0	1.8	6.3	3.0	19.6
Cat. Pop. 4	3.3	3.5	3.8	10.8	2.5	2.5	1.8	6.8	3.5	21.1
Cat. Pop. 5	3.0	3.5	3.8	10.3	1.8	2.0	1.8	5.6	3.0	18.9
Cat. 1246/16	3.0	2.8	3.0	8.8	1.3	1.5	1.5	4.3	3.0	16.1
Caturra	3.5	3.8	2.8	10.1	2.5	2.8	2.3	7.6	2.3	20.0
Catimor 129	3.8	3.3	2.5	9.6	3.5	3.0	2.5	9.0	2.8	21.4

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APPENDIX 2: Working Paper A1063/2

Catimor Management Survey, Misuku Hills and Viphya North, 2003

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A W Orr

Natural Resources Institute, University of Greenwich, UK

With

Allan Chawinga
Eddings Jambe
Fanwell Kalera
Osman Kayange
Young Jere
Peter Msiska
Aaron Munthali
Moses Mvula

Smallholder Coffee Farmers Trust

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Executive summary

A structured questionnaire survey was used to explore growers' management practices for a sample of 66 early Catimor adopters in Misuku Hills and Viphya North Associations. The survey recorded management practices for Catimor seedlings from transplanting in 2001 or 2002 until the 2003 season. The objective was to determine how far growers had adopted recommended practices and to identify growers' problems and information needs for Catimor.

Growers had an average of 332 bearing Catimor bushes in 2003, accounting for 30 % of bearing bushes. Total production in 2003 averaged 1216 kg of cherry. Adoption was highest in Misuku Hills where growers had over 500 trees Catimor bushes and production in 2003 averaged over 1500 kg of cherry.

The majority of growers used fertiliser and pesticides for coffee, with fertiliser mostly obtained on credit through SCFT. In 2003 expenditure on these inputs for coffee averaged 2200 MK/household. Expenditure on fertiliser for maize averaged 3799 MK/household. Thirty-five percent of growers reported they were unable to obtain as much fertiliser as they needed. Very few growers used Compound J and Lime, while CAN and 23:21:0 + 4S were widely adopted.

Growers reported their three most common problems with Catimor as WSB, fertiliser, and general pests. CBD was a minor problem. Growers' main information needs were for information on pest management, fertiliser rates, and disease management. In addition, growers requested information about agronomic practices such as spacing, trench planting, irrigation, and general crop management. Again, few farmers requested information about CBD.

On Catimor management, growers' management practices closely followed recommendations on terracing, mulching, manuring, and the frequency of weeding. But generally growers had not adopted recommended practices about hedgerow planting, planting in pure stand, or the use of lime and J Compound fertiliser. Most growers fertilised Catimor seedlings using CAN and 23:21:0 + 4S. Low use of lime and J Compound may reflect problems of availability rather than inability to pay.

Growers' fertiliser application rates were generally above the recommended rate. Application rates for J Compound averaged 103 grams/tree, compared to the recommended rate of 50 grams/tree. Application rates for CAN ranged from 49 grams/tree in year one to 72 grams/tree in year two, compared to recommended rates of 25 grams/tree and 50 grams/tree, respectively. Application rates for 23:21:0 +4S averaged 65 grams/tree in year one and 85 grams/tree in year two, compared to a recommended rate of 25 grams/tree in year one and 50 grams/tree in year two. This suggests that there is considerable scope to improve the efficiency of fertiliser use and reduce the costs of fertilising coffee.

SCFT fears of labour shortages after expansion of Catimor may be misplaced because (1) the labour market is active (2) institutions are flexible, with scope for payment in kind rather than in cash (3) migrant labour has not yet been tapped (4) households claim that family labour is sufficient to manage up to 1,000 trees.(though at yields below 10 kg/tree).

Introduction

Smallholder coffee in Malawi is in the midst of a Green Revolution. This is necessary to break into international markets, and projections suggest this level of production will be reached by 2011. By 2015, production is projected to reach 10,000 mt of parchment per annum, or treble the production the industry reached at its peak in the early 1990s. At current gross margins (15 MK/kg) it would result in an annual cash injection of roughly 69 million MK/annum (US $ 0. 9 million) into the smallholder sub-sector.

The transition to high-input smallholder coffee has risks. Just as Malawi's Green Revolution in maize has been frustrated by the availability and high cost of imported fertiliser, so the success of the Green Revolution in smallholder coffee depends critically on the issues of input supply and input management. The issue of input supply is being addressed in the short term through savings and credit schemes, which will ensure growers who are credit-worthy of timely supplies of the right type of fertiliser. In the longer term, the Trust hopes that all growers will be supplied through this source rather than relying on private trade.

The issue of input management is equally crucial. The technology underlying the new strategy involves dwarf Catimor bushes that require a high level of purchased inputs (especially fertiliser) and careful management. Figures show impressive uptake of Catimor seedlings, but there is little information about whether farmers are following the recommended management practices, which are crucial for sustaining high yields and reducing the risk of infection from pests and diseases. Catimor populations are as vulnerable to WSB as older varieties like Geisha, and probably more susceptible to CBD. In the worst-case scenario, failure to follow correct management practices now might result in future pest and disease outbreaks that could jeopardise Malawi's nascent smallholder coffee industry.

The objective of this study was to explore growers management practices for Catimor coffee. Specifically, the objectives were to:

- Assess the use and availability of purchased inputs like fertiliser and pesticides;
- Compare growers' management practices against the recommendations; and
- Identify growers' reported problems and information needs.

Data and methods

1. Catimor Management

Information on Catimor management was collected through a structured survey questionnaire (Appendix 1).

Survey coverage

Because resources were limited, the survey was conducted in only Misuku Hills and Viphya North Associations. Originally it was planned to sample farmers from only three zones (sections) in each Association but this was not possible because of limited farmer numbers. Table 1 shows the sections that were surveyed and the number of growers surveyed in each section.

Sampling

Since the objective of the survey was to explore management of the new Catimor varieties, farmers will be selected from those planting Catimors in 2001 (Misuku Hills) and 2002 (Viphya North). Lists of farmers planting Catimor in these years were obtained from the Association offices.

Although the original plan was to stratify the sample of Catimor growers into small, medium, and large growers, this was not possible because of the limited number of farmers planting Catimor in 2000-01 (Misuku) and 2001-2 (Viphya North). A total of 66 farmers were surveyed, 35 in Misuku and 31 in Viphya. This included nearly all the first growers to plant Catimor in six zones (three in Misuku, three in Viphya North). In Mondo section in Misuku Hills, where Catimor 129 was introduced in 1996 and has spread from farmer to farmer, care was taken to exclude growers with this variety.

Sample size

Because of resource constraints, the sample size was set at 30 farmers per Association.

Survey administration

The questionnaire was pre-tested with five farmers in Misuku Hills and five in Viphya North. Eight enumerators were trained, including two from LARS, and three each from Misuku Hills and Viphya North EPAs. One half-day's training was given in interview techniques, and one full day's classroom training in the survey questionnaire. This was followed by one half day's practical training in four groups with sample farmers. The survey was conducted between 3-9 October 2003, after the harvest of the 2003 coffee crop. Interviews were conducted in the specific field where growers had planted their first Catimor seedlings, to allow interviewers to verify reported statements on Catimor management.

Processing

The questionnaires were processed using SPSS and retained by LARS.

2. Labour management

Information on labour management for Catimor was collected through discussion with two groups of growers. The first group consisted of small-growers who expected to have more than 1000 bearing Catimor trees within 2-3 years. The second group consisted of larger growers who already had 1000 or more bearing Catimor trees. The purpose in selecting these two groups was to explore changes in labour management that might be expected once growers had more than 1000 bearing trees. One thousand is regarded by the SCFT as the minimum number of Catimor trees required to obtain a reasonable income from coffee.

In practice, the two groups turned out to be a mixture of small and large growers (Table 1). The median value of bearing Catimor trees was 1,200 and 1,400 in Groups 1 and 2, respectively. Therefore, the results were analysed as for one group.

No.	Name	Bearing trees now	Young coffee now	Bearing trees in the future
	Group # 1			
1	Michael Khita *	1,200 *	500	1,700
2	Synet Mbughi	5,100	700	5,800
3	Wydon Chawinga	500	450	950
4	Agnes Kayange	1,400	800	2,200
5	Grydness Namumbo	2,000	400	2,400
6	Eviness Kanjele	500	1,500	2,000
7	Chiston Khita	200	-	200
	Group # 2			
1	Cosam Msukwa *	1,400 *	500	1,900
2	Jane Mwiba	1,650	500	2,150
3	Evanson Kayange	2,500	800	3,300
4	Emms Nanshani	1,000	500	1,500
5	Henry Msukwa	800	600	1,400
6	Tony Chabinga	6,540	300	6,850
7	Denis Msuku	1,000	400	1,400
8	Pearson Masebo	1,500	200	1,700
9	Miney Kabwuye	800	500	1,300
10	Phillip Mogha	1,400	620	2,020
11	Anyandwile Kayuni	1,700	350	2,050

* Median grower

Each group was asked to draw a seasonal calendar of rainfall and labour use for coffee, which was used as the basis for discussion on several topics. These included the timing of operations for coffee; labour use for foodcrops; the types of hired labour available; and trade-offs in labour for coffee with labour for other crops. Beans were used as counters to record differences between months, with 10 indicating the highest level.

Socio-economic profile

The sample households were agriculture-based, with an average of four-fifths of their cash income from agriculture (Table 2). Their main source of cash income from agriculture was coffee, which accounted for two-thirds of cash earned from farming. Households were reasonably food-secure, with an average 10 months' self-sufficiency in maize, the preferred staple. Growers in Misuku Hills were better off than growers in Viphya North, with significantly higher food security and more cattle that could be sold to meet household crises.

The sample farmers were experienced and most had grown coffee for 20 years. About 8 in 10 growers owned a radio and thus had access to information on coffee through this medium. Men, women, and children participated in weeding and harvesting coffee.

Fewer than half the sample growers reported hiring labour for weeding or harvesting. Hiring labour for harvesting was more common in Misuku Hills, where households planted more coffee.

A socio-economic profile based on total number of trees (bearing and young coffee) showed that bigger coffee-growers were better-educated, had more assets (brick-houses, iron-sheet roofs, male cattle, cows, and calves) than smaller growers (Table 3). They were also more likely to hire labour for harvesting coffee, though not for weeding.

Coffee production

Growers had planted Catimor for three seasons, starting in 2000 (Table 3). The average number of Catimor seedlings planted in 2001 and 2002 was similar in both Associations, but new plantings declined sharply in Viphya North in 2003. The average number of bearing Catimor bushes was significantly higher in Misuku Hills (503 trees) than in Viphya North (139 trees). On average, Catimor accounted for 30 % of bearing trees. The share in Misuku Hills was 42 % compared to only 14 % in Viphya North. Cherry production in 2003 was about twice as high in Misuku Hills (1555 kg) as in Viphya North (831 kg).

Use of purchased inputs

Fertiliser

All except four growers used inorganic fertiliser in 2003 (Table 4). On average, growers spent MK 5513 on fertiliser, of which 1714 MK (31 %) was for coffee and 3799 MK (69 %) was for maize. The quantity of fertiliser used for coffee in Misuku Hills was significantly higher than in Viphya North, as was the amount used for maize. The SCFT was the main source of fertiliser in both Associations, with depots located on average about 7 km distance from the homestead. Twenty-three growers (40 %) reported that they were unable to get as much fertiliser as they wished in 2003, mostly from Viphya North Association.

Pesticides

On average, growers spent MK 486 on pesticides for coffee in 2003 (Table 5). Expenditure was significantly higher in Misuku Hills (630 MK). Dursban and Copper Oxychloride were the most popular purchases, and were bought by roughly half the sample. Other pesticides were bought by only 15 % of growers (Daconil) or 9 % of growers (Fenitrothion, or Fungeran). Only 20 growers (30 %) purchased Teepol.

Availability

Growers were asked whether specific inputs were available (ie. physically present), available on time, and available in the amount required (Table 6).

Results showed wide variation in the availability of inorganic fertiliser. Of 66 growers, only three growers (5 %) reported that Compound J was available at the right time and only two growers (3 %) reported that Compound J was available in the right quantity. Similarly, only nine growers (14 %) reported that lime was available at the right time and only 10 (15 %) that it was available in the right quantity. The situation was better with Can and 23:21:0 + 4S. The majority of growers reported that these fertilisers were available at the right time and in the right quantity.

Problems and information needs

Problems

Catimor growers reported that their major problems lay with pests and with fertiliser (Table 7). Thirty-two growers (48 %) reported a problem with WSB, and 24 (36 %) reported problems with other pests (particularly miners, scalers, and termites). Thirty growers (45 %) reported a problem with fertiliser, specifically the heavy fertiliser requirement for Catimor compared to Geisha, and the high relative cost of fertiliser inputs. Fewer farmers reported problems with diseases and only 7 growers (11 %) reported a problem with CBD.

Information needs

Growers reported a variety of information needs on Catimor, of which the most important were general information on pest management (25 responses, 22 %), fertiliser rates (17 responses, 15 %), spacing (13 responses, 12 %), and WSB (11 responses, 9 %). However, farmers also requested information on trench planting, crop management (including how to combat soil erosion), and irrigation.

Catimor management

Questions about management referred to the first Catimor bushes planted by growers, and covered a period of three years for bushes planted in 2000 or two years for bushes planted in 2001.

To compare practices between growers, growers were divided into three groups (terciles) according to the number of Catimor bushes planted in the first year of adoption These groups corresponded approximately to growers planting < 100 bushes, 200 bushes, and 500 + bushes (Table 9). Results showed that:

- Of 54 growers that planted Catimor on sloping fields, 39 (72 %) had terraced their fields.
- Only 21 growers (32 %) had adopted hedgerow planting on the trench system, while the rest preferred conventional spacing.
- Spacing averaged 2.6 metres between rows and 1 metre between planting stations.
- The majority of growers (61 %) intercropped coffee with other crops, usually bananas.
- The majority of growers manured (80 %) and mulched (74 %) seedlings in the year they were planted (year one)..
- Bushes were weeded three times yearly on average.

- Twenty four growers (36 %) applied Compound J in the year they were planted (year one) and 12 growers (18 %) applied Compound J in the year after planting (year two).

- Only 11 growers (17 %) applied lime to seedlings at planting.

- Growers applied Compound J at the average rate of 103 grams/tree at planting.

- Growers applied CAN and 23:21:0 + 4S at average rates of 49 grams/tree and 65 grams/tree, respectively, at planting (year one).

- Growers applied CAN and 23:21:0 + 4S at average rates of 72 grams./tree and 85 grams/tree, respectively, in the year after planting (year two).

- Approximately half the growers applied Daconil (50 %) and Copper Oxychloride (59 %) to coffee seedlings in the year after planting (year two).

No significant differences were found in management practices between the three groups. The single exception was that fewer growers in the smallest size category (group 1) applied Compound J at planting.

Box 1. Case Study: Catimor 129

Austin Mwenechanya planted Catimor 129 in 1996/7, the year this variety was released in Malawi. He was selected as a demonstration farmer for Catimor 129 by researchers, and got advice on planting from research staff then stationed at Misuku Hills. His garden of 180 trees is situated in a small valley. The crop has been growing now for eight years. Mr. Mwenechanya reported that yields were still rising, except for a drop last year caused by over-bearing. Last years' yield was only 160 kg. But the previous year (2001) the yield was 2000 kg or roughly 10 kg/tree.

For fertiliser, he applies 100 grams/tree of 23:21 soon after the rains, followed by 100 grams/tree of CAN in March. He routinely applies three pesticides:

1. Lepas, applied once per year too control leaf rust.
2. Copper, applied twice to control leaf rust, once at the start of the season and again after one month.
3. Dursban, applied once at the start of the season to control stem borer.

He has not had any disease problems except for one tree with CBD this year. He had not seen WSB (*namipembe*) in this field, maybe because trees had grown to provide a protective skirt around the stems before the current epidemic.

He mulches and manures his crop every year. He weeds once, but not in the rainy season because of the danger of erosion. Mulch effectively keeps the weeds down.

Since 2000, he has supplied Catimor 129 seed to about 20 farmers per year who ask him for seed. He supplies 2 kg to each farmer free of charge. Most farmers are from this zone, but he has also given seed to farmers from Chisi and Chuwa zones.

Labour management

Seasonal distribution of labour

For coffee, the seasonal labour peaks were in January (carrying seedlings from the nursery to the field and planting), February (weeding), March (weeding and fertiliser application), and August-September (harvesting). August is the peak month for harvesting on warmer, lower slopes while September is the peak month for harvesting on higher slopes near the forest.

For foodcrops, the peak months were in January (applying fertiliser and first weeding of maize), March (second application of fertiliser, and second weeding for maize), and August (shelling maize and preparing land for *dimba* crops).

In the event of conflicts between family labour for coffee and for foodcrops, households reported that they would reduce family labour for foodcrops like sweet potato and groundnuts.

Family labour

Adults worked full time on coffee, with no reported gender division of labour. (Indeed, wives often had separate coffee gardens to guarantee they received some of the income from coffee). Husbands and wives shared labour on both coffee gardens, however. A gender division of labour existed for foodcrops, where women were responsible for planting beans and sweet potato, harvesting beans, and weeding groundnuts (for which a small hoe was used). School-age children were only available to help with coffee at weekends.

Growers in Group 1 were asked the maximum number of trees that they could manage using only family labour.

- Agness Kayange reported that her household managed 1,400 coffee trees with seven family members (husband, wife, and five children).

- Michael Khita reported that his household managed only 650 trees with two family members (himself and his wife) and to manage his 1,200 trees he needed to hire labour.

- Grydness Namumbo reported that with 2,000 trees she had to hire labour.

- Synet Mbughi had 5,000 trees and hired ganyu labour. Tony Chabinga (Group 2) with 6,540 trees, employed three permanent workers for coffee.

In general, Group 1 growers agreed that households could manage 1,000 trees with a family of five members. Above this figure, households had to hire labour for coffee.

Hired labour

The peak months for hired labour for coffee were October (terracing, filling planting holes) December (carrying seedlings to field and planting) March (weeding) and August-September (harvesting).

Growers reported three types of non-family labour for coffee.

- *Nyitira*, or group labour paid with a cooked meal for a day's work.
- *Ganyu*, or labour paid in cash or kind for piecework.
- *Fumirana*, or exchange labour between relatives, paid with snack food..

Nyitira was reported to be the most common method of hiring labour, followed by *ganyu* and then *fumirana*. *Ganyu* was used primarily in February (weeding) and August-September (harvesting). Nyitira was preferred to ganyu because it was cheaper and growers might not have cash available at that time (SCFT growers are paid for coffee in December, after deductions for credit).

Hired labour was used for any activity, except applying fertiliser where there was a risk of theft. *Ganyu* was usually male, but women were preferred for harvesting coffee because they worked faster, could carry more on their heads than men, and would accept payment in kind (soap, sugar, beans) whereas men wanted to be paid in cash. Growers reported no problems with the availability of hired labour, only with their ability to pay for it. Hired labour was exclusively local in origin, with no reports of labour migrants.

Further details of how different methods of hiring labour work at the household level may be found in the Case Study (Box 1). .

Box 2. Case study: Labour management

Wydon Chawinga (45) lives with his wife (39), six children aged 20-2 years, and an orphan girl aged 19 in Katowo zone, Misuku Hills. He first planted coffee in 1981 after he married but discontinued in 1984 and only started re-growing in 2001. He now has 500 bearing Catimor trees, with 80-100 Geisha, and has 2,700 Catimor young coffee trees. His wife has also planted 500 Catimor seedlings, which is the number required to become an SCFT member. Within the next few years, therefore, this household expects to harvest coffee from over 3,000 Catimor bushes. They expect Catimor yields of 10 kg/tree this year because they have applied a lot of fertiliser. Bearing trees received one application of 23:21 in January, and split applications of CAN in February and March.

Coffee is the main source of cash for the household, though carpentry and tinsmithy also provide non-farm income. With favourable rains, the family usually enough maize to last until December, buying for three months a year between January and March. The family also earns cash from the sale of beans and sweet potato, but this income belongs to his wife. Similarly, his wife has her own coffee field to ensure that she sees some of the income from coffee, which might otherwise remain with him.

At present, the family manages its coffee using mostly family labour. The main workers are Wydon, his wife, and three younger children aged 16-7, who participate at weekends. Two older children and the orphan Kate attend secondary school and work in coffee only in vacations. Despite their separate fields, husband and wife share the labour for coffee.

So far he has used hired labour for terracing, making planting holes, and for harvesting, using the *nyitira* system. First, he plans in advance when to do the task, in order to avoid clashing with other households using nyitira on the same day. This is parrticularly important at harvesting. Next, he estimates the number of people needed to complete the task in one day. Finally, he invites those he wants to participate. For terracing and digging planting holes, he chose coffee growers and close relatives but for harvesting he may invite non-growers. Only those aged 16 or over may participate. At the end of the day, he paid the workers with a meal of *nsima* and chicken. He prefers *nyitira* to *ganyu* because it is cheaper to pay workers with a meal than in cash or inn maize, which he may not to spare when needed. He employs *ganyu* only for weeding and harvesting maize, when he is pressed with a lot of other activities. He won't use *ganyu* to weed coffee because he believes it would not be done correctly.

Wydon prefers *nyitira* to *fumirana* or exchange labour, which may involve 4-5 families of friends and relations. Big families may not want to help others with less labour, because there is strict reciprocity, so *fumirana* might involve all the working members of a small family but only some members of a large family. This creates ill-feeling and jealousy, so much so that families who use *fumirana* might call on distant relatives rather than those living nearby. *Fumirana* is less intensive than *nyitira*, with participants ending work at 8 a.m. and receiving only snacks like sweet potato in payment.

With 3000 bearing Catimor trees, Wydon expects to have more cash to hire *ganyu* for coffee. So that he can devote more time to coffee he will also hire labour to help him with carpentry and tin-smithy. Already, he has to stop these activities when weeding maize and harvesting coffee. His wife believes *ganyu* may not be needed for coffee because they can continue to use *nyitira* and their children's labour. If necessary, she will reduce the area planted to sweet potato and beans, from which she gets some income.

Discussion

Income from coffee

The socio-economic profile showed the importance of coffee for rural livelihoods in Misuku Hills. Growers in this Association relied more heavily on coffee for cash than in Viphya North, with little cash income from other crops. This reflected the greater distance to urban markets and the cost of transport. As a result, farmers in Misuku Hills plant more coffee, with an average of 1204 bearing trees compared to just 988 in Viphya North. They have also adopted Catimor more quickly, planting an average of 1366 bushes compared to 1013 bushes in Viphya North. This investment is beginning to bear fruit, with cherry production reaching 1555 kg in 2003 compared to 831 kg in Viphya North.

	Misuku Hillls	Viphya North
Gross income from coffee (@ 10 MK/kg)	15,550	8,310
Fertiliser	1,771	1,649
Pesticides	630	324
Pulpery	1,555	831
Total cash costs	3,956	2,804
Net income from coffee	11,594	5,506

At 10 MK/kg of cherry, these production figures give incomes from coffee of MK 15,500 in Misuku Hills and MK 8,300 in Viphya North in 2003. Subtracting expenditure on fertiliser, pesticides, and processing suggests that net income from coffee, on a cash-cost basis, averaged MK 11, 594 in Misuku Hills and MK 5506 in Viphya North. It should be recalled that growers selected

Catimor management

Analysis of growers' management practices for Catimor seedlings showed that:

- Growers have *adopted* recommendations for Catimor seedlings on mulching, manuring, frequent weeding, and terracing sloping fields.

- Growers have *not adopted* the recommendation about hedgerow planting of Catimor or about planting in pure stand. Most Catimor seedlings were planted as separate bushes, and in Misuku Hills growers have continued to intercrop Catimor with bananas.

The text table below shows the recommended fertiliser management practices for Catimor, produced by the SCFT.

Age of tree	**Type of Fertiliser**	**Rate (grams/tree)**	**No. of applications**
To Planting hole	Manure Lime Single superphosphate *	20 litres na 100	1 1 1
1st season	23:21:0 + 4S CAN***	25 25	1 1
2nd season	23:21:0 + 4S J. Compound **** CAN	50 50 50	1 1 1
3rd season	23:21:0 + 4S J. Compound CAN	100 100 100	1 1 1

Source: C. S. M. Chanika (2004).

* mixed with topsoil to fill the top half (30 cm) of the hole.

*** use any other fertiliser that can supply equivalent amount of nitrogen.

**** use any other fertiliser that can supply equivalent amount of potassium.

Comparing the recommendations with growers' fertiliser management practices shows that:

- Growers *have not widely adopted* the use of lime or J Compound at planting.

- Growers have widely adopted the recommendation to use CAN and 23:20:0 + 4S.

- Growers used an average rate of 103 grams/tree of J Compound in the planting year (year one), while there is no recommendation to use this fertiliser at this time by researchers.

- Growers used average rates of 49 grams/tree and 79 grams/tree for CAN in years one and two respectively, compared to the recommended rates of 25 grams/tree in year one and 50 grams/tree in year two.

- Growers used average rates of 65 grams/tree and 85 grams/tree for 23:21:0 + 4S, respectively, compared to the recommended rates of 25 grams/tree in year one and 50 grams/tree in year two.

These findings relate closely to growers' reported problems and information needs about Catimor. Fertiliser was the second-most frequently mentioned problem with Catimor (Table 7), and growers reported information about fertiliser rates as their second-most important information need (Table 8). The findings show that growers generally apply fertiliser above the recommended rates. This suggests that there is scope to improve efficiency by supplying growers with better information.

The lack of adoption of lime and J Compound may reflect lack of availability as much as lack of knowledge. For example, J Compound was not available in 2003 because of disruption in the supply from Zimbabwe. On the other hand, the majority of growers use CAN and 23:21:0 + 4S because these are widely available. The problem with these fertilisers is likely to be cost rather than availability. Here it is relevant to note that 35 % of the sample growers reported that they were not able to obtain as much fertiliser as they wished (Table 4).

In sum, the findings show that growers have unmet information and financial needs for fertiliser for coffee.

Labour management

The SCFT has expressed fears that future growth in coffee planting and yields will face a labour constraint at peak periods. Our evidence suggests otherwise, because:

- The labour market in Misuku Hills is already quite active, with 26 % of sample households hiring labour for weeding, and 38 % hiring labour for harvesting (Table 2). Households with more coffee trees were more likely to hire labour for harvesting, but there was no significant difference between the number of trees and use of hired labour for weeding (Table 3). This suggests that the main labour constraint lay with harvesting.

- Labour markets are flexible, with several options for households that are short of family labour. Communal labour paid with cooked food is a traditional institution for coping with labour shortages in farming systems where households are not fully integrated into the cash economy. The *nyitira* system is widely used by coffee growers in the Misuku Hills and gives households without cash access to the labour market at peak periods. Similarly, households reported that women hired for harvesting would accept wages in kind rather than cash. Cash-wages for piecework (*ganyu*) remains relatively uncommon, reflecting the shortage of cash income found even among fairly large coffee growers.

- At present, growers rely solely on local labour and do not employ migrants from outside the area. Statistics show a total of 1,465 registered male coffee growers in Misuku Hills, accounting for 33 % of the total 4,430 farm households in the Association. This suggests that more local labour is available for coffee, and that there is scope to meet further demand for hired labour through seasonal in-migration.

- Finally, growers reported that a family of five could manage 1,000 bearing coffee trees without the need for hired labour. This is the SCFT's target figure to give households a reasonable income from coffee, and to qualify as a "prime farmer" for access to credit. If true, the demand for hired labour with Catimor may be less than previously projected. However, growers will have based their estimate of labour requirements on lower yields than the 10 kg/tree projected by the SCFT.

References

J. Biscoe (2003). Report of Short Term External Consultancy on Coffee Husbandry. SCFT, July. Mimeo.

C. S. M. Chanika (2004). Fertiliser Management in Catimor Coffee. Paper presented at Coffee IPM meeting, 25th May.

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Table 1. Sample growers, 2003

Zone	Association		
	Misuku Hills	Viphya North	Total
Kakomo	6		6
Mondo	11		11
Sokola	7		7
Katowo	10		10
Khanga		18	18
Uzumara		6	6
Mpompha		5	5
Jinthajembe		2	2
Total	35	31	66

Table 2. Socio-economic grower profile, by Association

Variable	Misuku Hills (n = 35)	Viphya North (n = 31)	Total (n = 66)	*P* >
Age	44	47	45	.5831
Year started growing coffee	1985	1983	1984	.4391
Education (% heads with JCE and over)	34	26	33	.6009
Maize self-sufficiency (months)	11	9	10	.0148
Income from agriculture (%)	80	78	79	.7412
Agriculture income from (%):				
Coffee	67	54	61	.0085
Other crops	16	33	24	.0003
Livestock	17	12	15	.1132
No. households owning:				
Tin-roof house	16	13	29	.7575
Brick-built house	33	21	54	.0053
Radio	29	28	57	.3776
Bicycle	6	17	23	.0013
Sprayer	19	15	34	.6823
Livestock owned (no.):				
Male cattle	0.51	0.06	0.30	.0021
Cows	2.23	0.39	1.36	.0000
Calves	1.29	0.12	0.74	.0000
Pigs	4.37	4.03	4.21	.7115
Goats	0.80	1.06	0.92	.6043
Family labour used for weeding (no.):				
Males	1.60	1.68	1.64	.7531
Females	1.63	1.58	1.61	.8549
Children	0.80	1.77	1.26	.0028
Family labour used for harvesting (no.):				
Males	1.77	1.65	1.71	.6243
Females	1.69	1.61	1.65	.7858
Children	1.40	1.77	1.58	.3085
No. households hiring labour for:				
Weeding coffee	9	8	17	.9932
Harvesting coffee	18	7	25	.0159

Table 3. Socio-economic grower profile, by number of trees (bearing and young coffee).

Tercile	1	2	3	P >
Trees (bearing and young coffee)	791	1965	4220	.0000
Age				
Year started growing coffee	1985	1985	1984	.9422
Education (no. household heads with JCE and over)	4	7	10	.0905
Maize self-sufficiency (months)	9.41	9.95	9.91	.7315
Income from agriculture (%)	82	74	81	.5500
Agriculture income from (%):				
Coffee	57	59	68	.1816
Other crops	31	23	18	.1088
Livestock	12	18	14	.3439
No. households owning:				
Tin-roof house	7	8	14	.0710
Brick-built house	16	16	22	.0256
Radio	20	16	21	.0671
Bicycle	9	4	10	.1263
Sprayer	7	10	17	.0083
Livestock owned (no.):				
Male cattle	0.14	0.18	0.54	.0212
Cows	0.50	1.45	2.14	.0153
Calves	0.23	0.77	1.23	.0048
Pigs	0.86	1.23	0.68	.6739
Goats	3.27	4.54	4.82	.3357
Family labour used for weeding (no.):				
Males	1.59	1.50	1.82	.5522
Females	1.41	1.41	2.00	.0971
Children	1.73	0.68	1.36	.0309
Family labour used for harvesting (no.):				
Males	1.64	1.64	1.86	.7082
Females	1.45	1.45	2.05	.1077
Children	1.77	0.95	2.00	.0452
No. households hiring labour for:				
Weeding coffee	5	4	8	.3570
Harvesting coffee	4	8	13	.0197

Source: Field Survey.

Table 4. Coffee production and Catimor plantings, by Association

Variable	Misuku Hills (n = 35)	Viphya North (n = 31)	Total (n = 66)	*P* >
Bearing coffee bushes, 2003 (no.):				
Catimor	503	139	332	.0009
Other varieties	736	857	793	.5482
Total	1239	996	1125	.2697
Catimor bushes planted (no.):				
2001	572	539	557	.8622
2002	484	411	450	.4834
2003	310	63	194	.0001
Cherry production (kg):				
2002	774	884	829	.6276
2003	1555	831	1216	.0327

Source: Field Survey.

Table 5. Fertiliser use, 2003, by Association

Variable	Misuku Hills (n = 35)	Viphya North (n = 31)	Total (n = 66)	*P* >
Households applying fertiliser to coffee (no.)	33	28	61	.3369
Quantity of fertiliser applied to coffee (kg/household):				
J Compound	0.0	1.9	0.9	.0610
Lime	4.0	0.7	2.4	.4355
CAN	130	57	96	.0008
23:21:0 + 4S	108	57	84	.0090
Quantity of fertiliser applied to maize (kg/household)				
CAN	99	60	82	.0003
23:21:0 + 4S	100	68	86	.0012
Fertiliser expenditure in 2003 (MK/household):				
Coffee	1771	1649	1714	.5192
Maize	4668	2817	3799	.0002
Main source of fertiliser:				
Trust/APIP	35	27	62	.0904
NASFAM	0	2	2	
Private dealer	0	0	0	
Other	0	2	2	
Distance to nearest fertiliser supplier (km)	7.0	7.6	7.4	.6185
Did you get as much fertiliser as you wanted this season (2003)?	26	9	35	.0028
Yes	8	15	23	
No				

Source: Field Survey.

Table 6. Pesticide use for coffee, 2003, by Association

Variable	Misuku Hills (n = 35)	Viphya North (n = 31)	Total (n = 66)	*P >*
Users (no.):				
Dursban	23	16	39	*.3617*
Daconil	5	4	9	*.8446*
Copper Oxychloride	18	15	33	*1.000*
Fenitrothion	1	4	5	*.2831*
Fungeran	2	0	2	*.5273*
Teepol	16	4	20	*.0008*
Average expenditure on pesticides (MK/grower)	630	324	486	*.0228*

Source: Field Survey.

Table 7. Availability of fertiliser and pesticides for coffee, 2003.

Input	Users (no.)	Available?	Available on time?	Available in amount required?
Fertiliser				
J Compound	3	3	3	2
Lime	3	9	9	10
CAN	59	64	45	48
23:21:0 + 4S	56	66	45	49
Pesticide				
Dursban	39	50	48	Na.
Daconil	9	25	23	Na.
Copper Oxychloride	33	45	43	Na.
Fenitrothion	5	1	1	Na.

Source: Field Survey.

Table 8. Reported problems with Catimor, by Association

Variable	Misuku Hills (n = 35)	Viphya North (n = 31)	Total (n = 66)	*P >*
White Stem Borer	29	3	32	*.0000*
Fertiliser	13	17	30	*.2328*
Other pests	15	9	24	*.3634*
Other problems	7	9	16	*.5709*
Other inputs	7	4	11	*.6591*
Other diseases	6	3	9	*.6012*
Coffee Berry Disease	7	0	7	*.0255*
Total	84	45	129	

Source: Field Survey.

Table 9. Reported information needs for Catimor, by Association

Variable	Misuku Hills (n = 35)	Viphya North (n = 31)	Total (n = 66)	*P >*
Pest management	10	15	25	*.1609*
Fertiliser rates	10	7	17	*.7845*
Disease management	7	8	15	*.7891*
Spacing	8	5	13	*.7070*
White Stem Borer	10	1	11	*.0152*
Trench planting	5	1	6	*.2581*
Crop management	2	3	5	*.8877*
Irrigation	0	4	4	*.0938*
Coffee Berry Disease	3	0	3	*.2817*
Other	5	8	13	*.3873*
Total	60	52	112	

Source: Field Survey.

Table 10. Catimor management, by number of bushes planted.

Variable	Tercile 1 (n=22)	Tercile 2 (n=22)	Tercile 3 (n=22)	Total (n=66)	*P >*
Bushes planted	74	191	645	303	*.0000*
Sloping fields (no.)	18	17	19	54	*.8688*
Terraced (no.)	12	13	14	39	*.8286*
Hedgerow planting (no.)	7	10	4	21	*.1517*
Distance between rows (m)	2.13	2.41	2.23	2.56	*.4261*
Distance between stations (m)	1.24	0.91	1.00	1.03	*.1208*
Intercropped (no.)	13	14	13	40	*.9385*
Growers mulching (no.)	15	15	19	49	*.2815*
Growers manuring (no.)	17	17	19	53	*.6817*
Vetiver grown (no.)	1	2	2	5	*.8054*
Weedings (no/yr.)	2.84	2.59	2.80	2.74	*.6580*
Fertiliser users (no.):					
J Compound (Yr 1)	3	10	11	24	*.0239*
J Compound (Yr 2)	2	7	3	12	*.1178*
Lime (Yr 1)	1	5	5	11	*.1746*
CAN (Yr 1)	13	15	13	41	*.7729*
CAN (Yr 2))	16	13	15	44	*.5547*
23:21 (Yr 1)	16	11	14	41	*.2942*
23: 21 (Yr 2)	16	17	10	49	*.0820*
Fertiliser rates					
(grams/tree):	163	97	65	103	*.2988*
J Compound (Yr 1)	38	60	49	49	*.1311*
CAN (Yr 1)	74	70	71	72	*.9656*
CAN (Yr 2)	65	66	63	65	*.9546*
23:21:0 + 4S (Yr 1)	94	79	84	85	*.6131*
23:21:0 + 4 S (Yr 2)					
Pesticide Users (no.):					
Dursban	2	3	6	11	*.2422*
Daconil	8	11	14	33	*.1947*
Copper Oxychloride	11	12	16	39	*.2681*
Fenitrothion	2	3	1	6	*.5769*

Source: Field Survey.

Table 11. Seasonal distribution of labour for coffee, Misuku Hills Association

Ganyu for coffee	000	000	-	000000	-	-	-	-	-	00000	00000	00
Hired labour for coffee	00000	000000000	00000000	00000	0000000000000	00000	000000	000	000	000000000	000000000000	0000000
Labour for coffee	00000	0000000	0000000000	0000000000	000000000000	00000	000	00000	0000000	000000000000	000000000000	0000000
Labour for foodcrops	00	0000	00000000	000000	00000000	0000	000000	000000	000	000000	0000	000
Rainfall distribution	0000	000000	00000000000000000	00000000	0000	000	00	0	0	0	-	-
Month	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct

Source: Discussions with two groups of Catimor growers, Katowo zone, May 2004.

Table 12. Seasonal distribution of activities for coffee and foodcrops, Misuku Hills Association.

Month	Coffee	Foodcrops
Nov	Manuring. Filling planting holes	
Dec	Planting in field First fertiliser application for young coffee (23:21) First weeding	Planting maize Planting sweet potato
Jan	Planting continues. First fertiliser application for young coffee First or second weeding. Spraying copper/Dursban Scouting for WSB	Weeding maize (1st) Fertilising maize (1st)
Feb	Second weeding. Gap-filling. Bark smoothing against WSB	Weeding maize (2nd) Fertilising maize (1st)
Mar	Second or third weeding Top-dressing mature coffee (CAN) Scouting for WSB	
Apr	Third weeding continues	Harvesting maize. Planting beans
May	Preparing mulch Digging planting holes Terracing. Digging trenches Preparing pulpery Spraying for green scales	Ridging for maize
Jun	Mulching Digging trenches or planting holes Terracing Harvesting starts	Harvesting sweet potato
Jul	Harvesting	Harvesting sweet potato. Harvesting beans
Aug	Peak harvesting month Digging trenches or planting holes Terracing	Dimba preparation/watering Composting dimba crops Making ridges for sweet

		potato vines. Harvesting beans. Maize shelling and bagging
Sep	Harvesting Digging trenches or planting holes Terracing Spraying copper/Dursban	Dimba crops
Oct	Filling holes Digging trenches Pruning Nursery management Rejuvenation	

<u>PROJECT R8204 [FTR Part 4]</u>
APPENDIX 3: Working Paper A1063/3

Catimor Impact Survey, Misuku Hills, 2004

January, 2005

F.M.T. Gondwe

Lunyangwa Research Station, Department of Agriculture Research Services,, Mzuzu, Malawi.

A. W. Orr

Natural Resources Institute, University of Greenwich, UK.

With

George M. Botha

Lunyangwa Research Station, Department of Agriculture Research Services, Mzuzu, Malawi.

Farewell M. Kalera
Moses Mvula
Osman H. Kayange
Peter K. Msiska
Victor J. Mkandawire
Young D. Jere

Smallholder Coffee Farmers Trust

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Abbreviations

CAB	Commonwealth International Bureau
CBD	Coffee Berry Disease
EPA	Economic Planning Area
LARS	Lunyangwa Agricultural Research Station
SCFT	Smallholder Coffee Farmers Trust
WSB	White Stem Borer

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Summary

The Smallholder Coffee Farmers Trust (SCFT) has promoted the high-input Catimor variety to increase smallholder income from coffee. The socio-economic impact of Catimor was explored through a survey of 95 coffee grower households in Misuku Hills Association, northern Malawi. Because the period of adoption covered only four seasons (2001-2004) the survey captured only the early impact of Catimor coffee. Nevertheless, the results were expected to provide first indications of the likely changes expected in the next 5-10 years.

All the sample growers grew some Catimor. For analysis, growers were divided into “early adopters” (defined as those that had planted 50 Catimor bushes in 2001) and “others”. ‘Early adopters’ (both husbands and wives) averaged 2002 bearing trees of which 1310 (65 %) were Catimor while ‘others’ averaged 1222 bearing trees of which 591 (48 %) were Catimor. Results showed that:

- The difference in household income between Early Adopters (Mk 67,000) and Others (Mk 57,000) was relatively small because the full impact of Catimor had yet to be felt. Net income from coffee in 2004 was similar for both groups (MK 11,000 for Early Adopters and MK 9,000 for Others). Among Early Adopters, income from farming had risen by 10 % since 2001. However, off-farm income among this group was still three times higher than among Others, reflecting higher investment in business.

- Income from banana was lower for Early Adopters, reflecting the SCFT recommendation to plant Catimors in pure stand. This confirms the importance of current OFTs to develop recommendations for intercropping coffee with banana.

- Asset ownership had increased sharply for both groups. Purchases included livestock assets (goats, cattle), housing (brick-built house, tin roofs), and consumer durables (radios). Households in both groups reported similar changes in expenditure patterns, with greater expenditure on meat, fish, sugar, clothes, soap, and paraffin.

- Household food security had risen for both groups. On average, maize-deficits fell from 3.5 months to 2 months for Early Adopters and from 3 to 1.5 months for ‘Others’. This reflected higher fertiliser use on maize through fertiliser credit.

- Catimor adoption had increased the use of hired labour for coffee and other crops. Most additional hired labour has been in the form of *nyitira* (group labour paid with a cooked meal) rather than through *ganyu* paid with cash wages. Households also reported reducing the area planted and the time spent working on crops other than coffee. This included crops like sweet potato and beans that where income traditionally belongs to women.

We therefore conclude that the livelihood impact of Catimor coffee has been positive and that this will help reduce poverty in northern Malawi, particularly in remote regions like Misuku Hills where few alternative livelihood strategies exist for households to earn cash income.

Introduction

Smallholder coffee in Malawi is in the midst of a Green Revolution. This is necessary to break into international markets, and projections suggest this level of production will be reached by 2011. By 2015, production is projected to reach 10,000 mt of parchment per annum, or treble the production the industry reached at its peak in the early 1990s. At current gross margins (15 MK/kg), this would result in an annual cash injection of roughly 69 million MK/annum (US $ 0. 9 million) into the smallholder sub-sector.

The success of the Green Revolution in smallholder coffee depends critically on the issues of input supply, input management it susceptibility to pests and diseases such as WSB and CBD. The issue of input supply is being addressed in the short term through savings and credit schemes, which will ensure growers who are credit-worthy of timely supplies of the right type of fertiliser. In the longer term, the Trust hopes that all growers will be supplied through this source rather than relying on private trade. The issue of susceptibility and control of pests and diseases is being addressed by LARS in collaboration with NRI and CAB International, Nairobi

The technology underlying the new strategy involves dwarf Catimor bushes that require a high level of purchased inputs (especially fertiliser) and careful management. SCFT statistics show impressive uptake of Catimor seedlings, but there is little information about the impact of the new technology on the farmers socio-economic status, which is crucial for sustaining the high adoption of the Catimor technology. Failure to follow the impact of the new technology now will reduce understanding of how likely growers are to achieve the SCFT targets, and delay implementation of corrective measures to ensure these targets are met.

The objective of this study was to explore the socio-economic impact of Catimor coffee on smallholder households. Specifically, the objectives were to assess the impact of the new Catimor technology on:

- Household income from coffee and other sources;
- Household assets and patterns of food consumption;
- Household food security; and
- Allocation of labour within the household, and on demand for hired labour.

Data and methods

Survey coverage

Because Catimor uptake was earlier in Misuku Hills Association, the survey was conducted in this Association only.

Sampling

Since the objective of the survey was to assess impact of the new Catimor varieties, farmers were purposively selected from growers that planted Catimor in 2001 that were sampled in the earlier Catimor Management Survey (Orr and Gondwe, 2004). To capture later adopters, we took a random sample from the lists of growers from the same four pulperies in 2004. A total of 95 farmers were sampled from four sections, namely Mondo, Sokola, Katowo, and Kakomo.

Sample size

For the purpose of analysis the sample farmers were divided into 'Early Adopters' and 'Other Farmers'. Out of 95 farmers, 48 farmers started growing Catimor before 2002, while 47 farmers started planting Coffee in 2002. Those farmers that had planted less than 50 trees of Catimor in 2001 were treated as 'Other Farmers' because the number planted is too small to have produced much impact. Unlike with the Catimor Management Survey, farmers that had started planting Nyika (Catimor 129) were included as 'Early Adopters'.

Survey administration

Data was collected using a structured questionnaire (Appendix 1) that was pre-tested with farmers in Misuku Hills. Eight enumerators were trained, including three from LARS, three from Misuku Hills, and two from Viphya North EPAs. One half-day training was given in interview techniques, and one full day classroom training in the survey questionnaire. This was followed by one half day practical training in four groups with sample farmers. The survey was conducted between 1-12 October 2004 after the harvest of the 2004 coffee crop.

Processing

The questionnaires were processed using Excel and SPSS and retained by LARS.

3.0 Results and discussion

3.1 Socio-economic profile

The gender profile differed slightly between 'Early Adopters' and 'Other Farmers', with 'Early Adopters' having a few more female headed households (Table 1). Also, the education profile for 'Early Adopters' had a normal probability shape while that of the 'Other Farmers' was skewed towards those with no formal education. 'Early Adopters' started growing coffee later that the 'Other Farmers'; they were more likely to be contact farmers; and had attended more field days than the 'Other Farmers'.

Table 1: Socio-economic profile for Early Adopters

No.	Item		Early Adopters	Others Farmers	Total
1	Gender (% Male)		85.4	89.4	87.4
2	Education	None (%)	8.3	19.1	13.7
		PSLC (%)	62.5	55.3	58.9
		JCE (%)	22.9	19.1	21.1
		MSCE (%)	6.3	6.4	6.3
		College (%)	0	0	0
3	Started Growing Coffee (Year)		1988	1985	1986
4	Contact Farmers (%)		27	8.5	17.9
5	Have Attended Filed Days (%)		81.3	74.5	77.9

3.2 Changes in income from coffee

Bearing bushes

All farmers in the sample had adopted Catimor. Table 2 shows the number of bearing bushes per varieties that the different farmers have and the percent of farmers that have them. By definition, all 'Early Adopters' grow Catimor. Table 2 shows that 'Early Adopters' had about twice as much bearing Catimor bushes as the 'Other Farmers'. The average Early Adopter' male farmer had 896 bearing bushes of Catimor, while Early Adopter female farmers had 414 bearing Catimor, and the 'Other Farmers' had 478.7 and 112 for male and female farmers respectively. The 'Early Adopter' category had more female farmers than 'Other Farmers', suggesting wives in male headed households were being encouraged to grow their own coffee. In general 'Early Adopters' grew more Catimor while 'Other Farmers' grew Geisha.

Table 2: Average Holding of Bearing Coffee Trees

No.	HH Head	Variety	Early Adopters	Others Farmers	Total
	Husband	Catimor	896.4 (85.4%)	478.7 (70.2%)	712.6 (78.9%)
		Geisha	627.4 (72.9%)	611.2 (89.4%)	619.1 (75.8%)
		Others	141 (14.6%)	62.8 (8.5%)	112.5 (11.6%)
		Average Total	1442 (85.4)	1004.3 (89.4%)	1234.5 (84.2%)
	Wife	Catimor	414.3 (25%)	112 (10.6%)	325.4 (17.9%)
		Geisha	277.8 (20.8%)	178.2 (23.4%)	225.6 (22.1%)
		Others	100 (2%)	100 (2.1%)	100 (2.1%)
		Average Total	560.7 (29.2%)	218 (25.5%)	402.7 (27.4%)

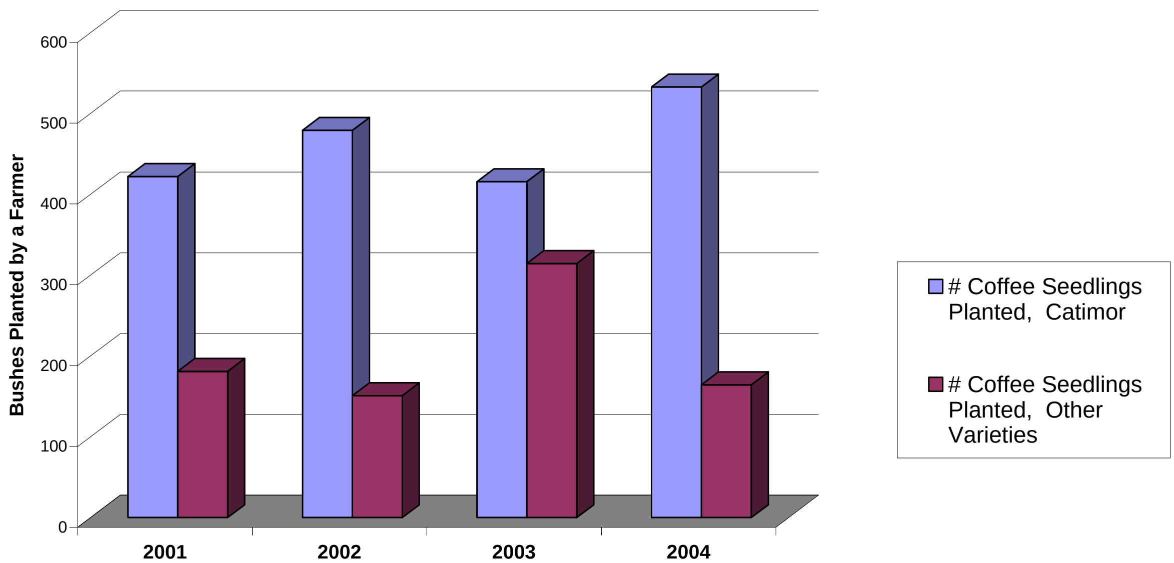
Note: Parentheses show percent of farmers in each adoption category growing the variety

b) Non-bearing bushes

The pattern of coffee planting shows a high degree of Catimor adoption. Early Adopters were planting two times more Catimor than the other varieties as seen in Graph 1.

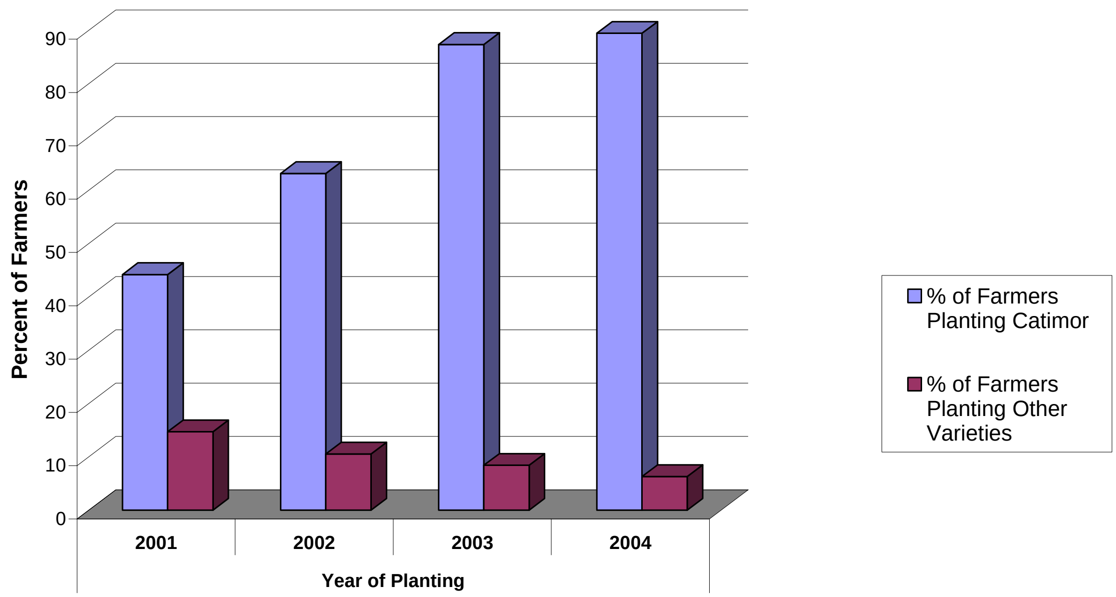
Geisha was the second most common variety while other varieties like Agaro or Caturra were less common. Since 2001, farmers were planting more Catimor than the other varieties.

Graph 1: Different Coffee Bushes Planted by a Farmer in a Year



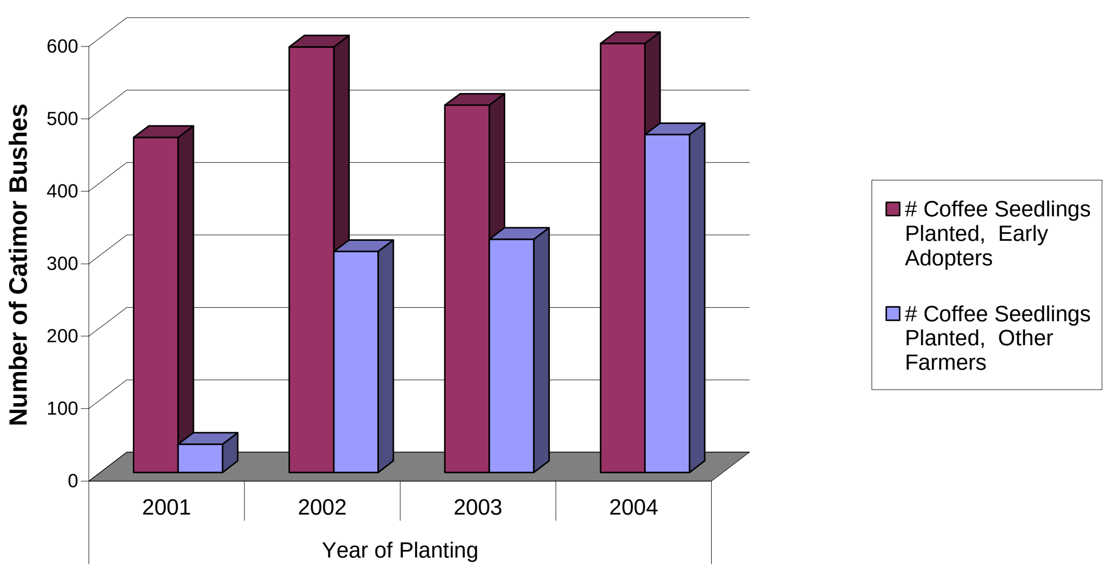
Graph 2 shows that the number of farmers growing Catimor was sharply increasing from 2001 to 2003. By 2003 close to 90% of all the coffee growers started growing Catimor. It also shows that the number of farmers planting other varieties was slowly going down. Since 2002 less than 10% of the farmers have been growing other varieties.

Graph 2: Percent of Farmers Planting Different Varieties Each Year



Graph 3 shows the different farmers were planting Catimor. By 2001 ‘Early Adopters’ were planting close to 500 bushes each year. The ‘Other Farmers’ started planting Catimor more in 2002 and they were planting relatively fewer trees each year compared to ‘Early Adopters’.

Graph 3: Number of Catimor Bushes Planted Each Year by Different Types of Farmers



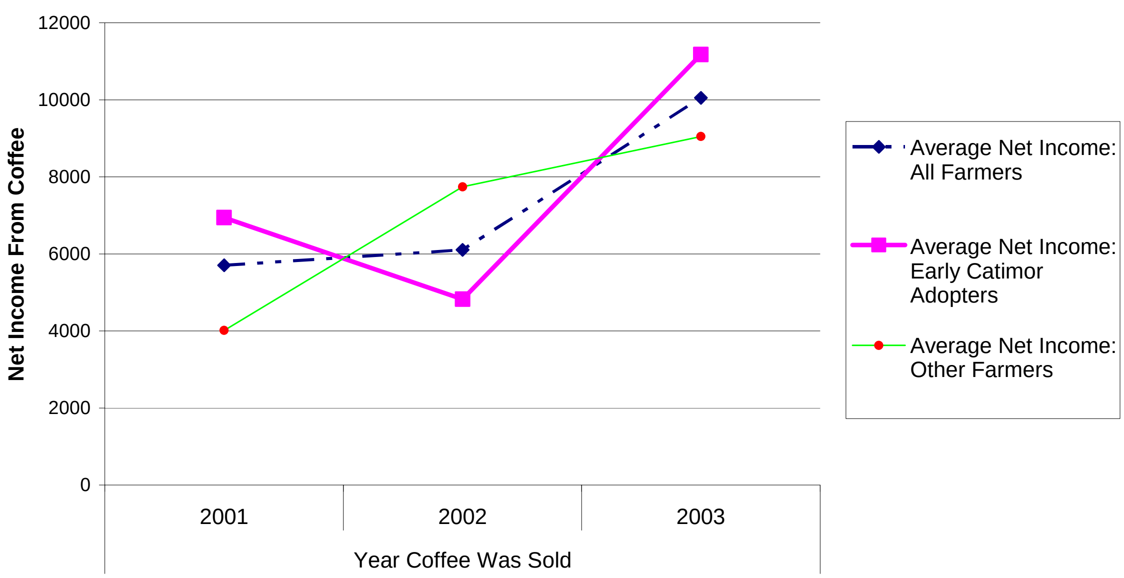
Coffee Production

Coffee yield per farmer in both 'Early Adopters' and 'Other Farmers' doubled between 2001-3. The share of farmers that are getting some yield has also doubled. In aggregate terms the sample totals have trebled showing that the Smallholder Coffee Farmers Trust (SCFT) is getting three times the yield it used to get in 2001. 'Early Adopters' were getting above1,000 kg but 'Other Farmers were getting just between 500 kg to 800 kg. The drop in yield was being attributed to the biannual bearing nature of Geisha unlike Catimor.

Table 3: Total Coffee Yield per Farmer and Percent of Farmers With Some Yield

	Early Adopters		Other Farmers		Sample Total kg
	Yield (kg)	% HH with Yield	Yield (kg)	% HH with Yield	
2,001	775.88	52.08	278.00	31.91	23,567
2,002	755.97	66.67	491.48	44.68	34,512
2,003	1,189.62	85.42	801.59	74.47	76,830
2,004	1,137.87	97.92	500.53	85.11	73,501

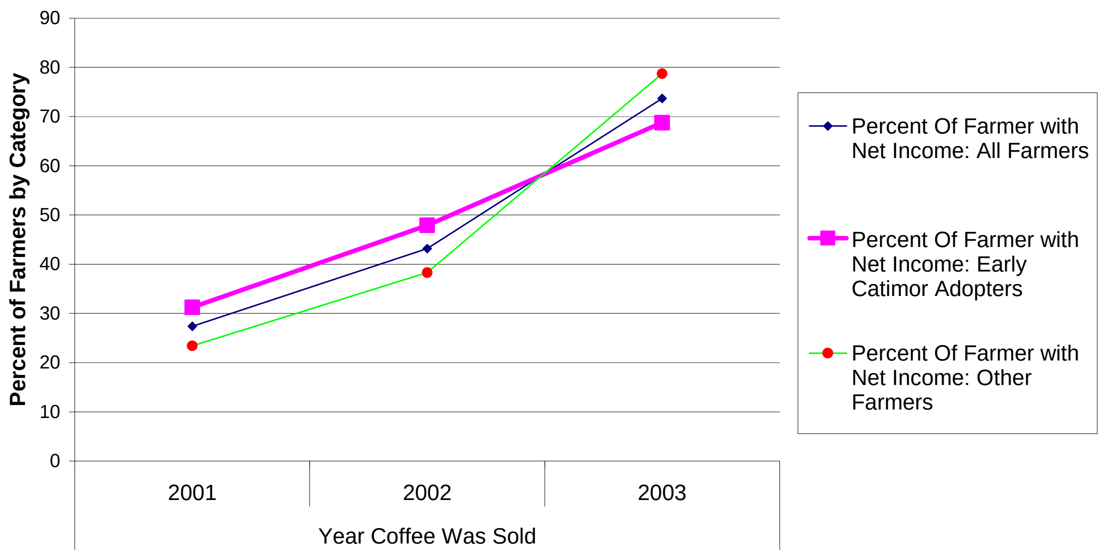
Graph 4: Net Income Trends By Different Types of Farmers



Graph 4 shows how different farmers were getting some net income from coffee over the years. In general net income had increased over the years and 'Early Adopters' were getting more net income from their coffee. In 2003 they were getting about MK11,000.00 a farmer while 'Other Farmers' were getting MK9,000.00 each. In 2002 'Early Adopters' had a net income drop from MK7,000.00 to MK5,000.00, This was probably due to loan repayment because coffee yield in 2002 did not drop.

The trend of farmers that are getting some net income however grew steadily from about 30% to 75%. Interestingly, more of the ‘Other Farmers’ (79%) received some net income compared to 69% of the ‘Early Adopters’ (Graph 5). This means that 30% of the ‘Early Adopters’ versus 20% of the ‘Other Farmers’ did not get any net income. All the coffee proceeds were used to payback the loan. The high average net income (Graph 4) and the high Catimor planting show that farmers were aiming for high income though some had yet to realise some net income.

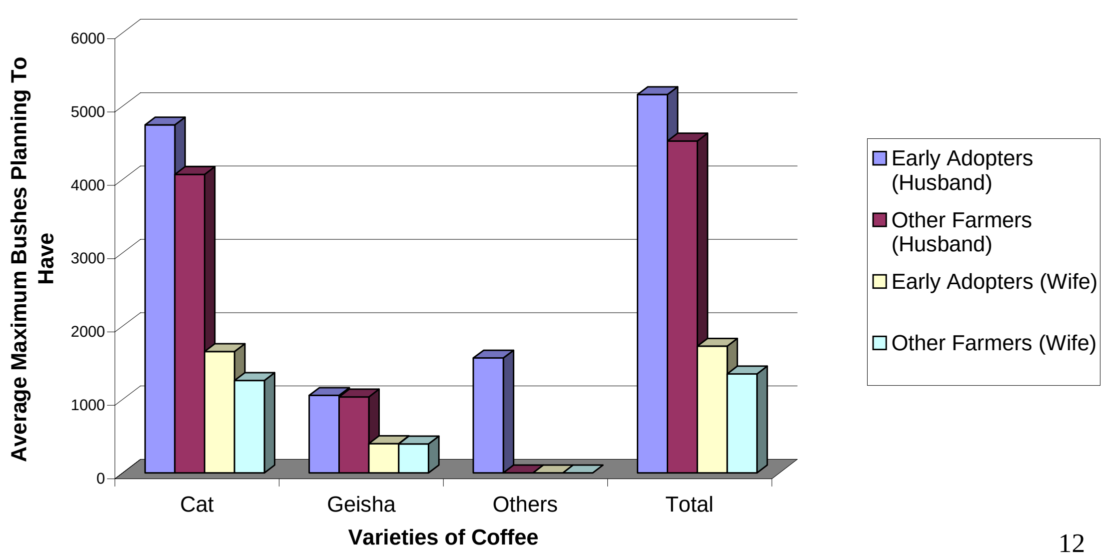
Graph 5: Trend of Farmers Obtaining Some Net Income From Coffee



Planned number of bearing coffee bushes

All farmers among those that were interviewed said they had plans of planting more coffee except one farmer who said that she was too old.

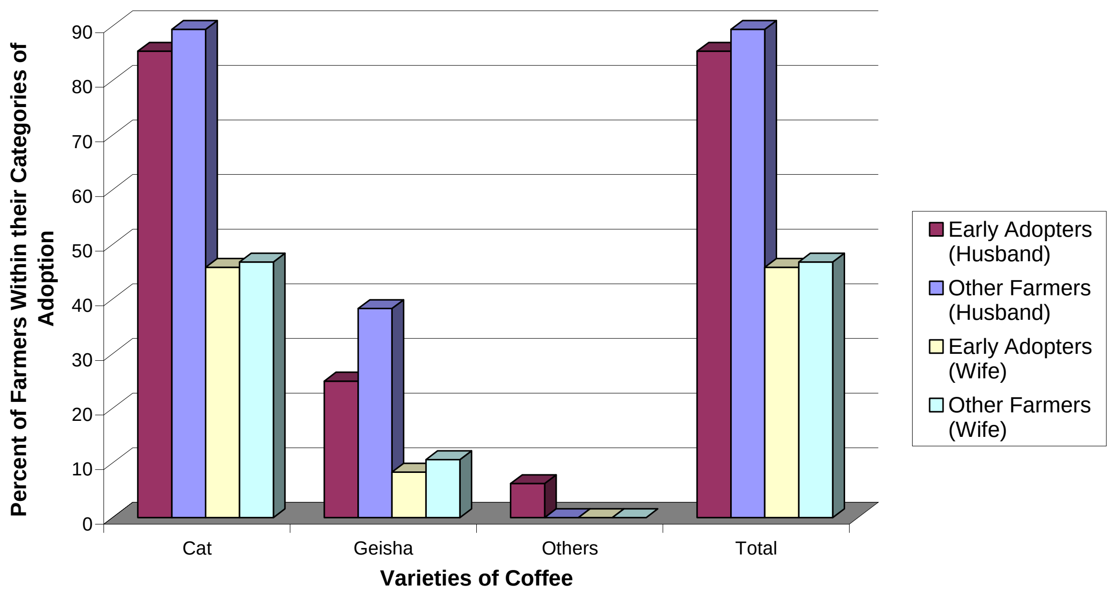
Graph 6: Maximum Number of Bushes That Different Farmers Plan To Plant on Their Fields



Graph 6 shows that all types of farmers planned to grow more Catimor that the other varieties. ‘Early Adopters’ both male and female were planning to have higher number of Catimor than their counterparts but the same number of the other varieties. Husbands of ‘Early Adopters’ planned to have a maximum of 4500 bearing Catimor bushes and the wives planned to have 1600 bushes of Catimor. Male ’Other Farmers’ wanted to have 4000 Catimor bushes while their wives wanted 1200 bushes. Among the other varieties Geisha is the one that farmers wanted to plant except male ‘Early Adopters’ who wanted more of other varieties.

Graph 7 shows that all husbands planned to grow Catimor and that more of the ‘Other Farmers’ wanted Geisha (25% versus 38%). Close to 50% of wives in both groups wanted to plant Catimor and about 10% wanted Geisha. Again, on the ‘Early Adopters’ it is noted that fewer wives wanted other varieties.

Graph 7: Percent of Farmers Planning to Plant Different Types of Coffee

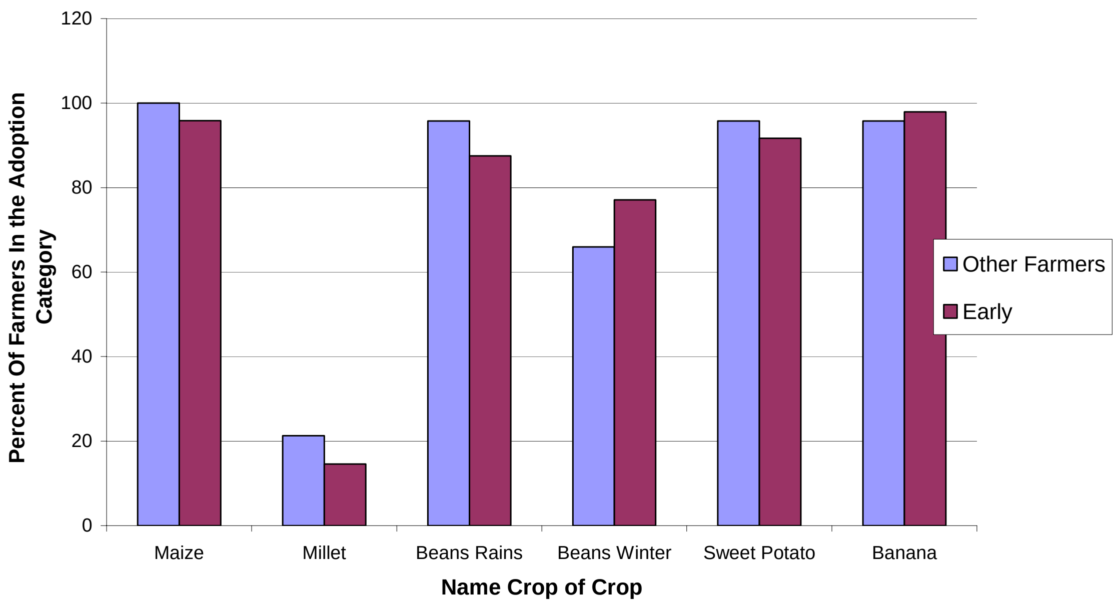


3.3 **Changes in other income sources**

Crops

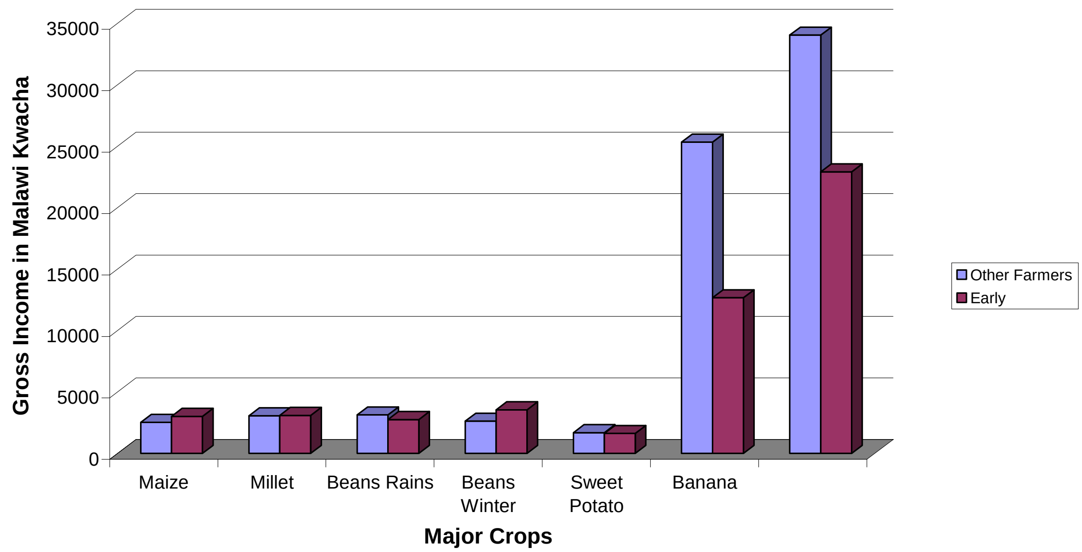
Almost all farmers grew maize, beans, sweet potato and banana but few grew millet. Except for winter beans and banana, slightly more 'Other Farmers' grew other crops than the 'Early Adopters' (Graph 8)

Graph 8: Farmers That Got Some Harvest From The Major Crops In 2004



Graph 9: shows that 'Other Farmers' had higher income value of other crops (especially from banana) than the 'Early Adopters'. 'Early Adopters' had less banana because bananas are mostly grown in coffee fields and Catimor coffee is being promoted in banana free fields. Also noticeable is that 'Early Adopters had slightly more income value from maize and winter beans.

Graph 9: Income Value of Other Major Crops Harvested by Different Farmers



Livestock

Table 4: Percent of Households that Have Some Livestock

	Male Cattle	Cows	Calves	pigs	Goats	Chicken	Total
Early Adopters	8.33	16.67	2.08	18.75	52.08	41.67	41.67
Other Farmers	14.89	10.64	2.13	27.66	36.17	48.94	48.94

Graph 10: Types and Number of Livestock Sold by Different Farmers

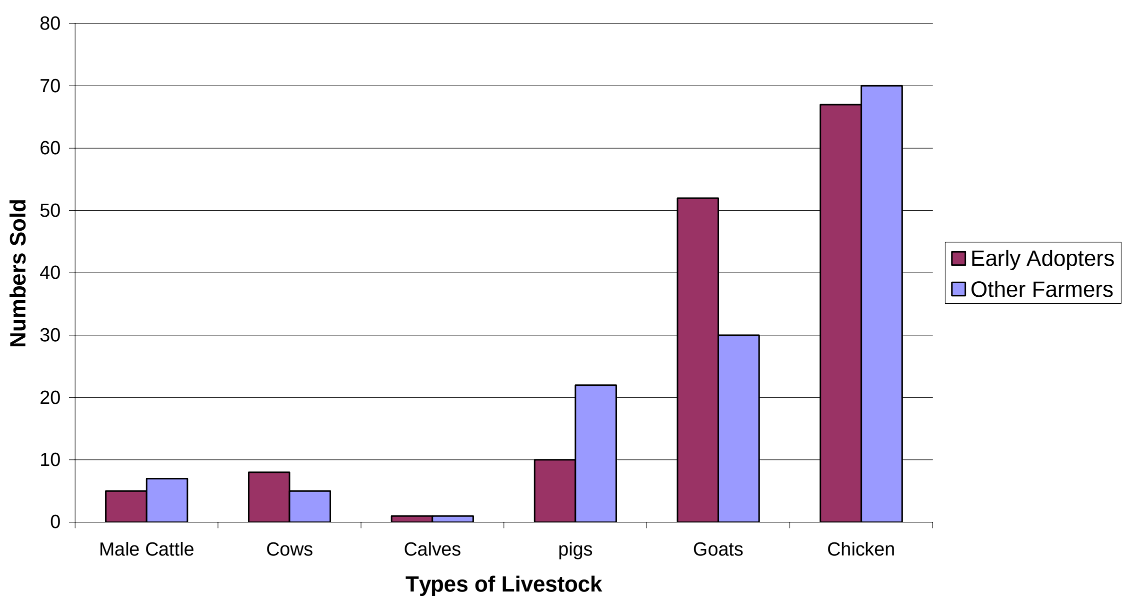
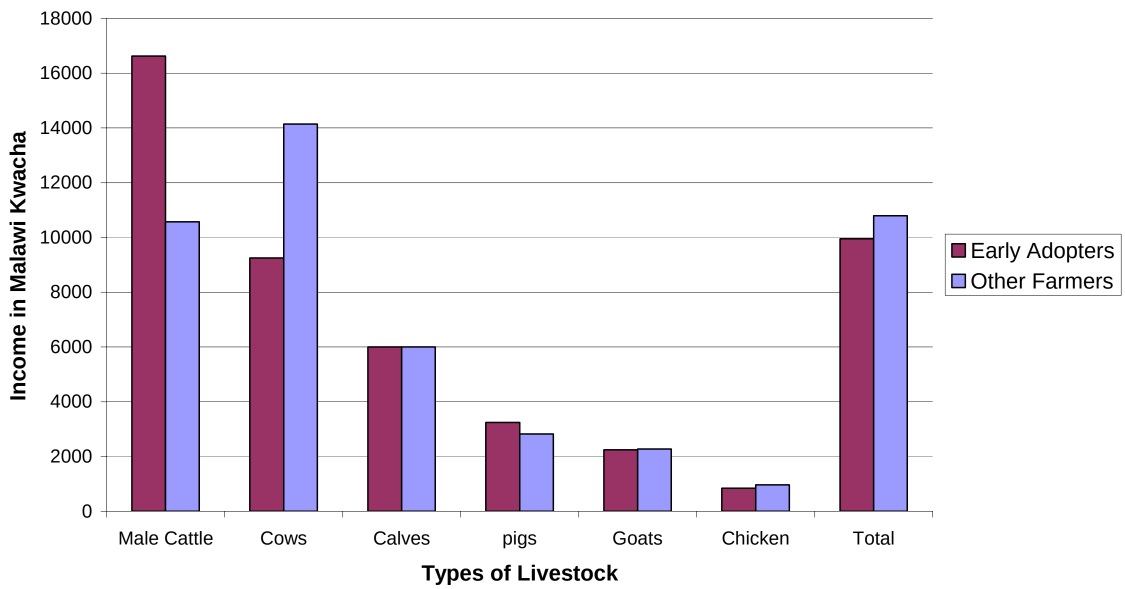


Table 4 shows that ‘Other Farmers’ had more livestock than ‘Early Adopters’, although ‘Early Adopters’ had more cows and goats than their counterparts. Graph 10 shows livestock sales in 2004. It was found that each group sold more from the types livestock of which they had more. Graph 11 shows that ‘Other Farmers’ received a little more income from livestock than ‘Early Adopters’. It is however interesting to note that while ‘Early Adopters’ got high value from male cattle ‘Other Farmers’ got high value from cows where, respectively each group, a few households are keeping the male cattle or cows. The rest of the other livestock are just about the same value.

Graph 11: Income From Livestock by Differernt Farmers



Off Farm Income

Table 5 Main Sources of Off-Farm Income

Male HH Early Adopters	Timber/Planks, Hawker, Salaries, Ganyu, Beer (Brewing and selling)
Female HH Early Adopters	Beer (Brewing and selling), Hawkers, Ganyu,
Male HH Others Farmers	Ganyu, Timber/Planks, Hawker, Gifts Salaries, Beer
Female HH Others Farmers	Ganyu, Hawker, Gifts

Table 5 shows the main types of off-farm income activities by the category of farmers in descending order. It was found that ‘Early Adopters mainly have business type of off-farm activities in the fore-front while ‘Other Farmers’ have ‘Ganyu’ (casual labour) as the most common activity.

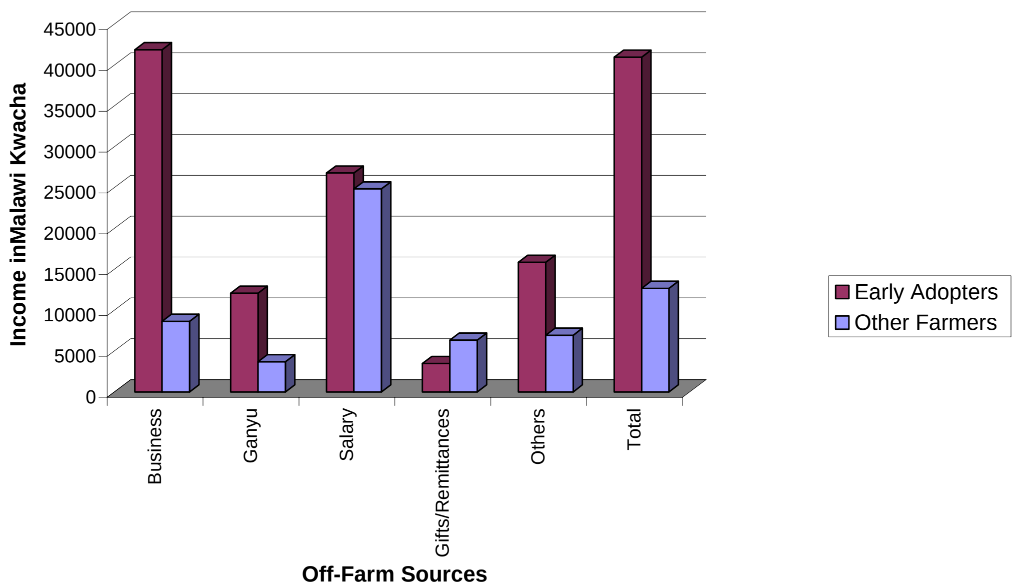
Table 6 shows that off-farm income activities are done by over 75% of the households in both groups of farmers. More of the ‘Other Farmers’ (80%) engage in off-farm activities than ‘Early Adopters’(75%).

Table 6: Percent of Household Doing Some Off-Farm Income Activities

	Business	Ganyu	Salary	Gifts	Others	Total
Early Adopters	47.92	16.67	18.75	18.75	18.75	75.00
Other Farmers	42.55	23.40	10.64	29.79	17.02	80.85

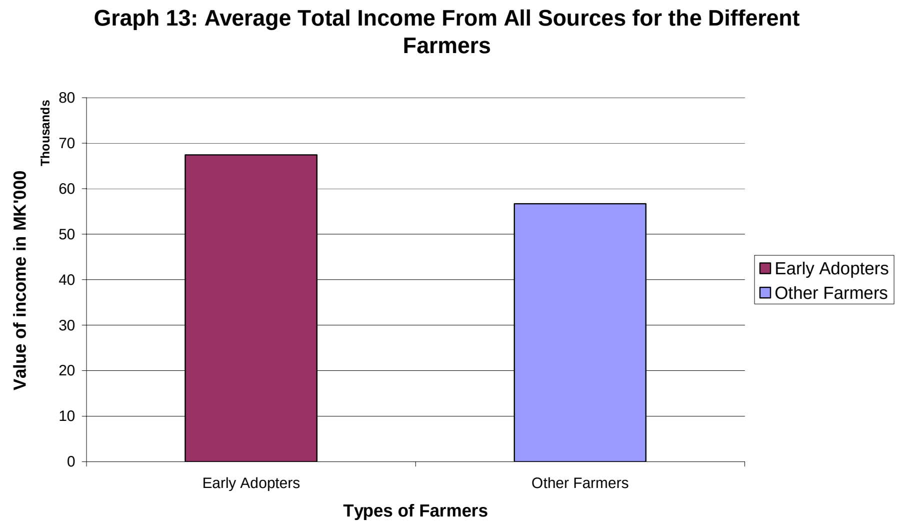
On average 'Early Adopters' get more income (MK40,000.00) than 'Other Farmers' (12,000) from off-farm activities and the major sources of the difference are business activities, 'Ganyu' (casual labour) and other activities (Graph 12). More business activities for 'Early Adopters' mean that there is more boosting of income status of the households. Capital for business investment most likely came from high income from Catimor

Graph 12: Income From Off-Farm Sources by Different Farmers



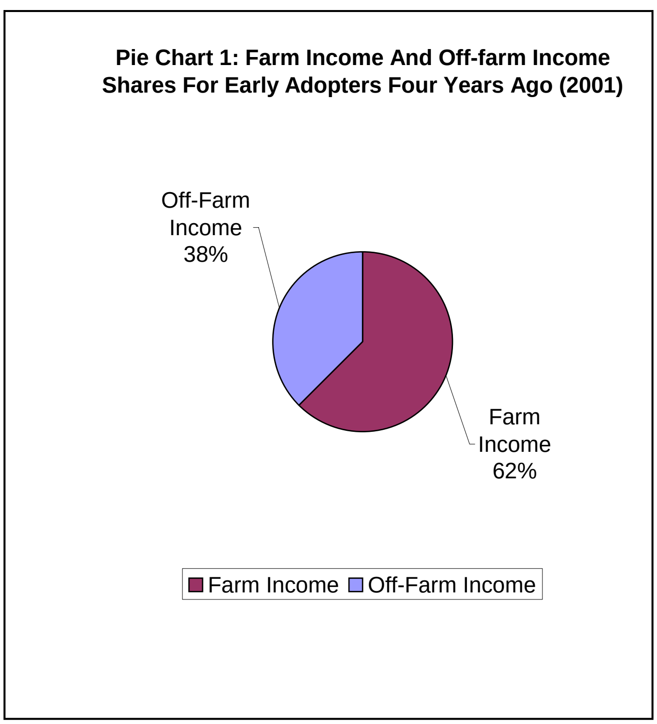
Total household Income

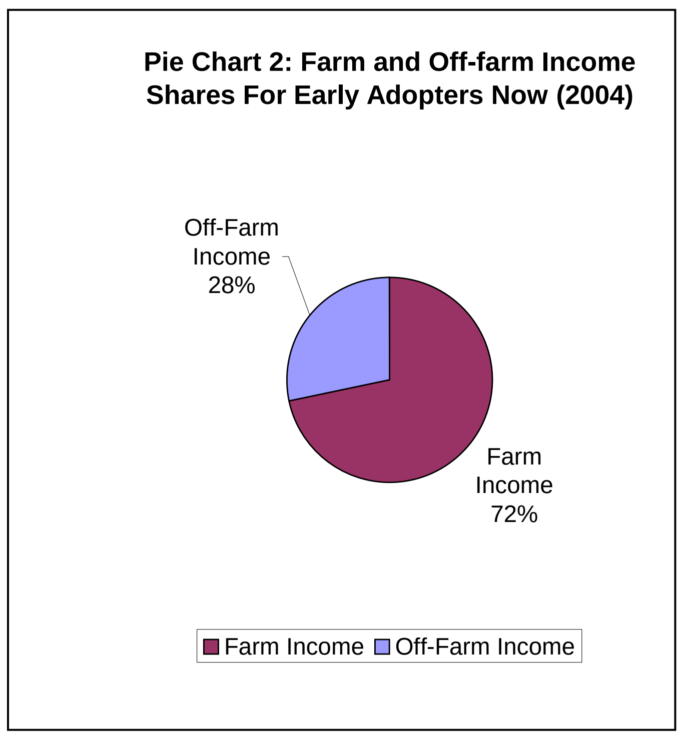
A total income value from the various income sources: coffee net income, value of other crops, income from livestock and income from off-farm activities was calculated for each farmer and the averages for the two groups was plotted into a graph to show the income differences for the two types of farmers. Graph 13 shows that 'Early Adopters' had higher total income (MK 67,000.00) than the 'Other Farmers' (MK 57,000.00). This income difference was quite important to show that Catimor had some positive impact to farmers that grow it.



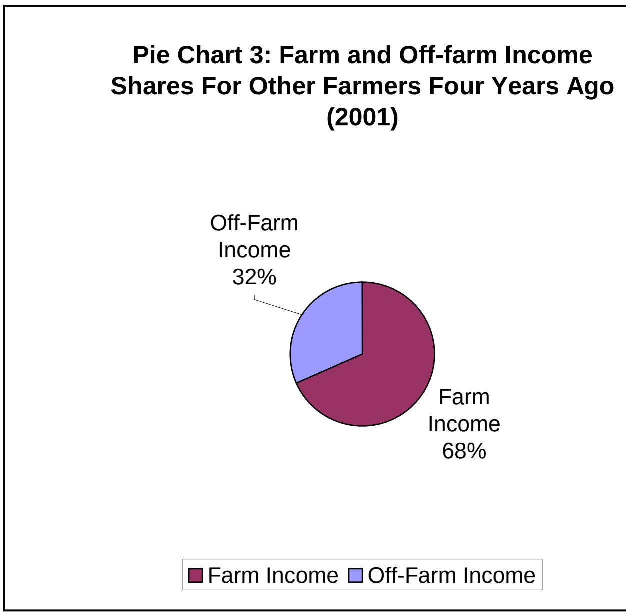
3.4 Changes in household income

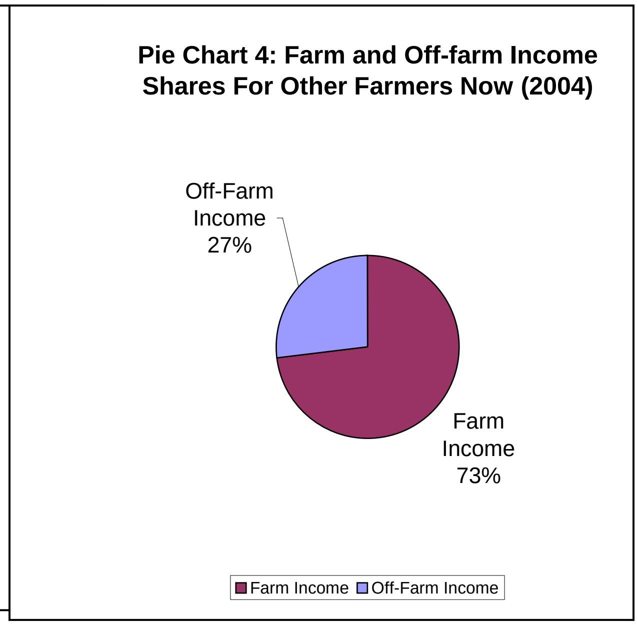
Comparison on cash income changes was made by asking the percent shares of off-farm and on-farm incomes between four years ago and now. The results have been plotted into pie charts below. Pie Charts 1 and 2 compare the income changes of 'Early Adopters'. The pie charts show that there is an increase in the shares of farm income to total income. There is a 10% increase.





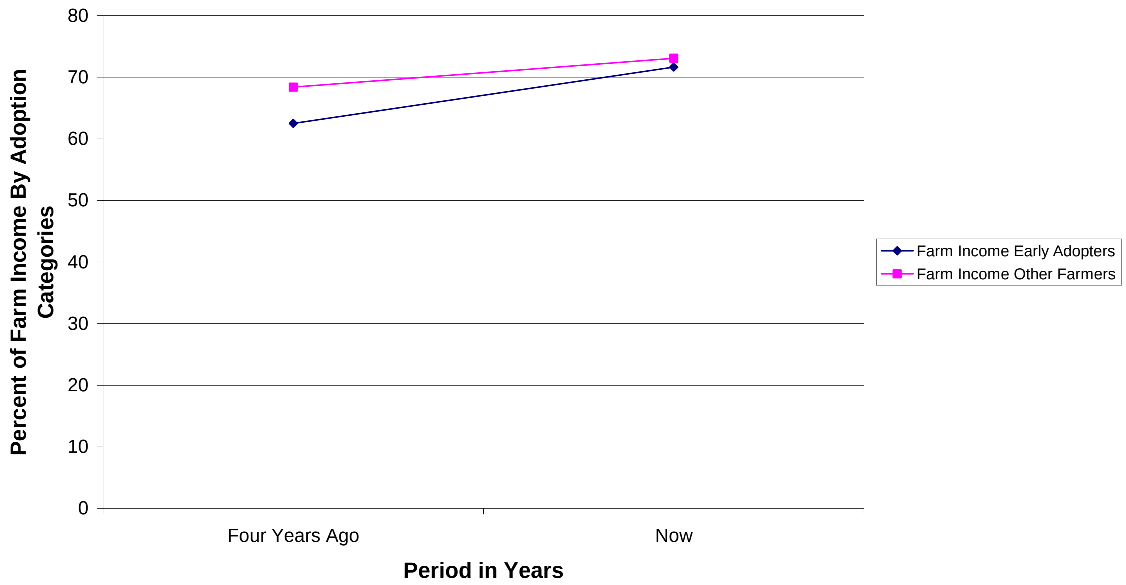
Pie Charts 3 and 4 compare the income changes of 'Other Farmers' and again they show an increase of shares from farm income against off-farm income. In general therefore the shares of farm income to total income have increased between 2001 and 2004. The shift, however, is bigger in 'Early Adopters' than in 'Other Farmers' (10% versus 5%). Previous results (Graph 12) would have suggested that 'Early Adopters' are getting more income from off-farm activities. However, it is clear that these farmers depend more on farm income and Catimor adoption is surely contributing to this income shift. These farm income trends were plotted into a line graph and the increases can be clearly differentiated from the line slopes (see Graph 14).





Graph 14 shows that 'Other Farmers' already had higher farm income than the 'Early Adopters'. With the passing of years and the adoption of Catimor, the percent of farm income to total income has steadily increased for both groups but much more for 'Early Adopters'. Since 'Other Farmers' have been getting lower coffee income these results confirm that they have depended more on other farm activities such as livestock and other crops. The income rises given the general price increases seem not adequate to match the income increase due to Catimor coffee.

Graph 14: Trends of Farm Income Shares For the Different Farmers



3.5 Reasons for changes in household income

The changes in household farm income have been either increasing or decreasing. In general, however, it has been shown that both groups of farmers have had increasing farm incomes. The major reason cited by both groups was that now the farmers have more income from coffee (Table 7).

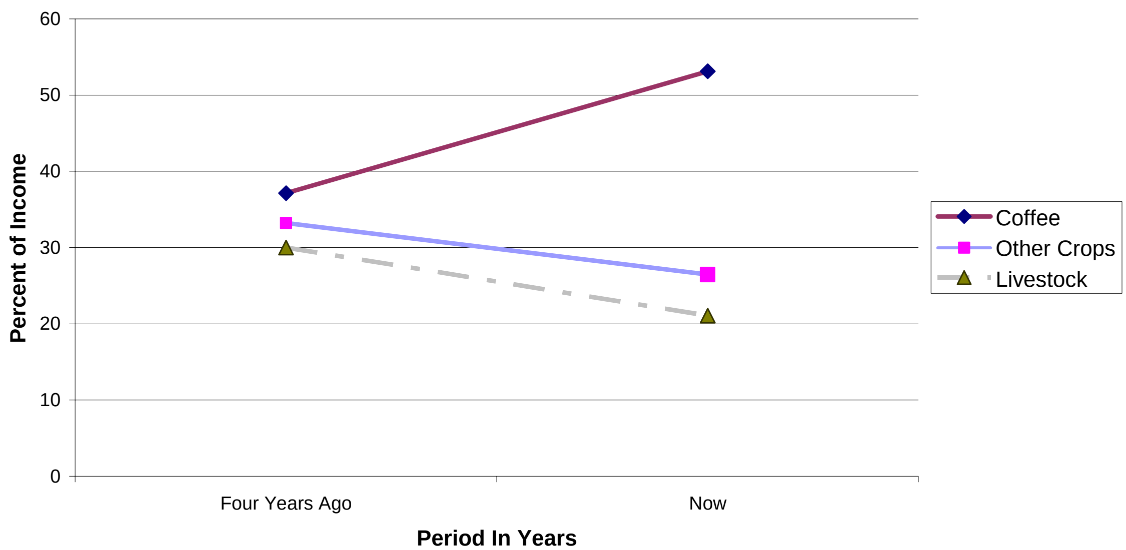
Table 7: Reasons for Changes in the Farm Income between 2001 and 2004

No	Reasons for Increasing Farm Income Share	Early Adopters	Other Farmers
1	More income from coffee	20.83	21.28
2	More income from coffee and other crops	12.50	4.26
3	Diversification	10.42	8.51
4	More income because Catimor (High yields)	10.42	6.38
5	Good Prices	4.17	4.26
6	Business Activities	2.00	-
	Reasons for Decreasing Farm Income Share		
1	Increased costs of Inputs	4.17	4.26
2	Loan repayment	2.08	4.26
3	Death of Partner	2.08	4.26
4	Over stressed with too many activities	0	8.51
5	Adverse weather	0	4.26
6	Old age of farmer	0	4.26
7	Over aged coffee/uprooted old coffee	0	4.26
8	Lack of Fertiliser	4.17	0
	Retired from salary job	2.08	0
	Reasons for No Change	18.75	6.38

Other farmers pointed out that they now had more farm income especially because they had planted Catimor which has higher yields compared to other varieties. A few farmers said that overall increases in produce prices had led to this increase in household income.

On the other hand farmers who experienced decreases in farm income attributed the decrease to cost of inputs, loan repayment and loss of family members (especially spouse) as the common reasons for the decrease. 'Other Farmers' also mentioned weather change as another important reason.

Graph 15: Trends of Income Shares From Different Source for Early Adopters



Graphs 15 and 16 show how farm income from different sources has behaved since 2001. 'Early Adopters' income had increased mainly due to coffee while income from other crops and livestock had declined. On the other hand, while coffee income had increased for 'Other farmers', income from livestock had been constant and income from other crops had also declined. The trend is better for 'Other Farmers' than for 'Early Adopters' because it shows that the farmers can still rely on other farm activities but it may have negative effects to 'Early Adopters' if other sources are being depleted.

Graph 16:Trends of Income Shares From Different Sources for Other Farmers

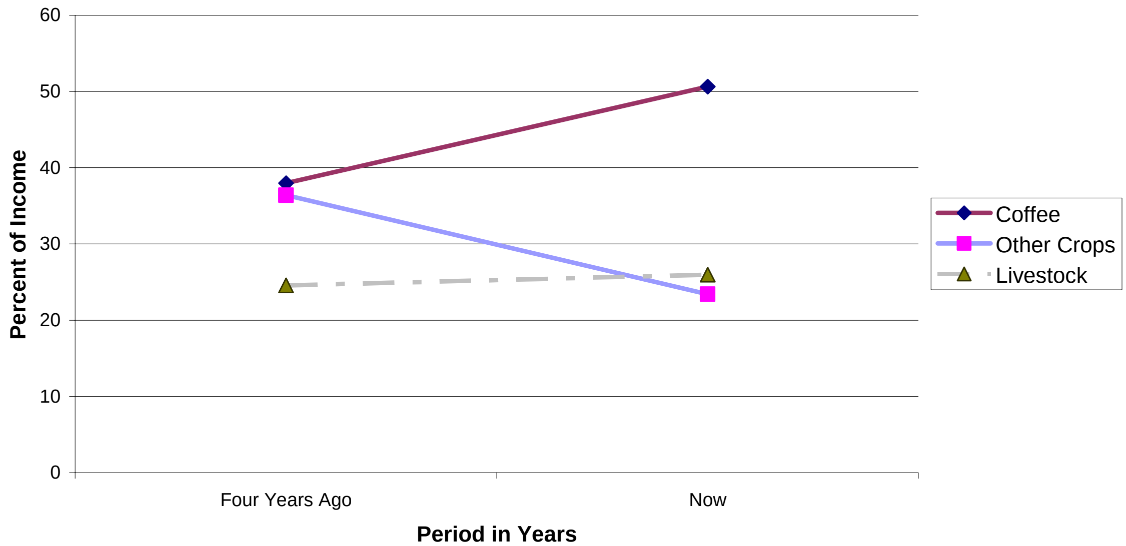


Table 8: Cash Income Change to Different Households

	Increased	Constant	Decreased
Early Adopters	89.58333	0	10.41667
Other Farmers	82.97872	6.382979	10.6383

Table 8 shows how the different farmers have experienced changes in their total cash income. In both groups, there was an equal percent of farmers (10%) that have had a decrease in cash income while over 80% have had an increasing cash income. In the 'Other Farmers' group 6% of the farmers said that their income had been constant.

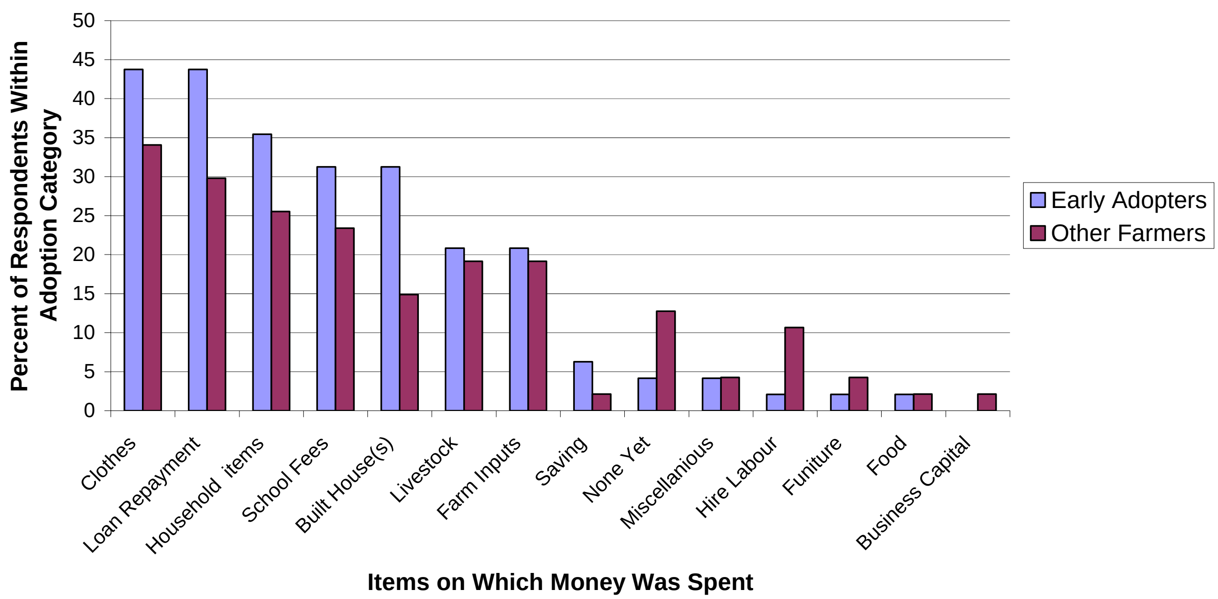
Table 9 Reasons for Changes in Household Cash Income for Different Farmers.

Reasons for Increase in Total Cash Income	Early Adopters	Other Farmers
Because of more coffee	45.83	27.66
Because Catimor coffee	25.00	17.02
More income from coffee and other crops	12.5	14.89
Because Diversification	6.25	10.64
Because of better coffee prices now	6.25	8.51
Business Activities	6.25	2.13
Good Prices	4.17	4.26
Because of good coffee Extension	2.08	0
Because Remittances	2.08	2.13
Reasons for Decrease in Total Income		
Over diversification	2.08	8.51
Loan repayment	6.25	2.13
Increased costs of Inputs	4.17	
Over aged coffee/uprooted old coffee	0	2.13
Lack of Fertiliser	2.13	0
Death of Partner	2.13	0

Table 9 show the reasons that have led to changes in household cash income for different farmers. It is clear from this table that farmers are attributing more of their cash income increases to having more income from coffee and more so due to Catimor varieties. Over 60% of farmers from both groups said the increase was due to coffee. Other reasons that were also mentioned included: diversification, better coffee prices now and business activities. On the other hand households have been experiencing decreases in household cash income due to over diversification, loan repayments and increased costs of inputs. Table 9 emphasises results of Table 7 by showing that coffee income has led to an increase in not only farm income but total household cash income.

The realised cash income is spent differently by different households (Graph 17) but in general it is spent mostly on household needs such as clothes and kitchen utensils, repayment of loan, school fees, and purchase of livestock and buying of inputs. This shows that it is mostly consumed than invested. It is interesting to note that more of 'Other Farmers' invested their cash income by spending on hired labour, livestock and farm inputs while more 'Early Adopters' spent their cash income on loan repayment and the other major expenditure lines.

Graph 17: How Different Farmers Have Spent Money They Got From Catimor

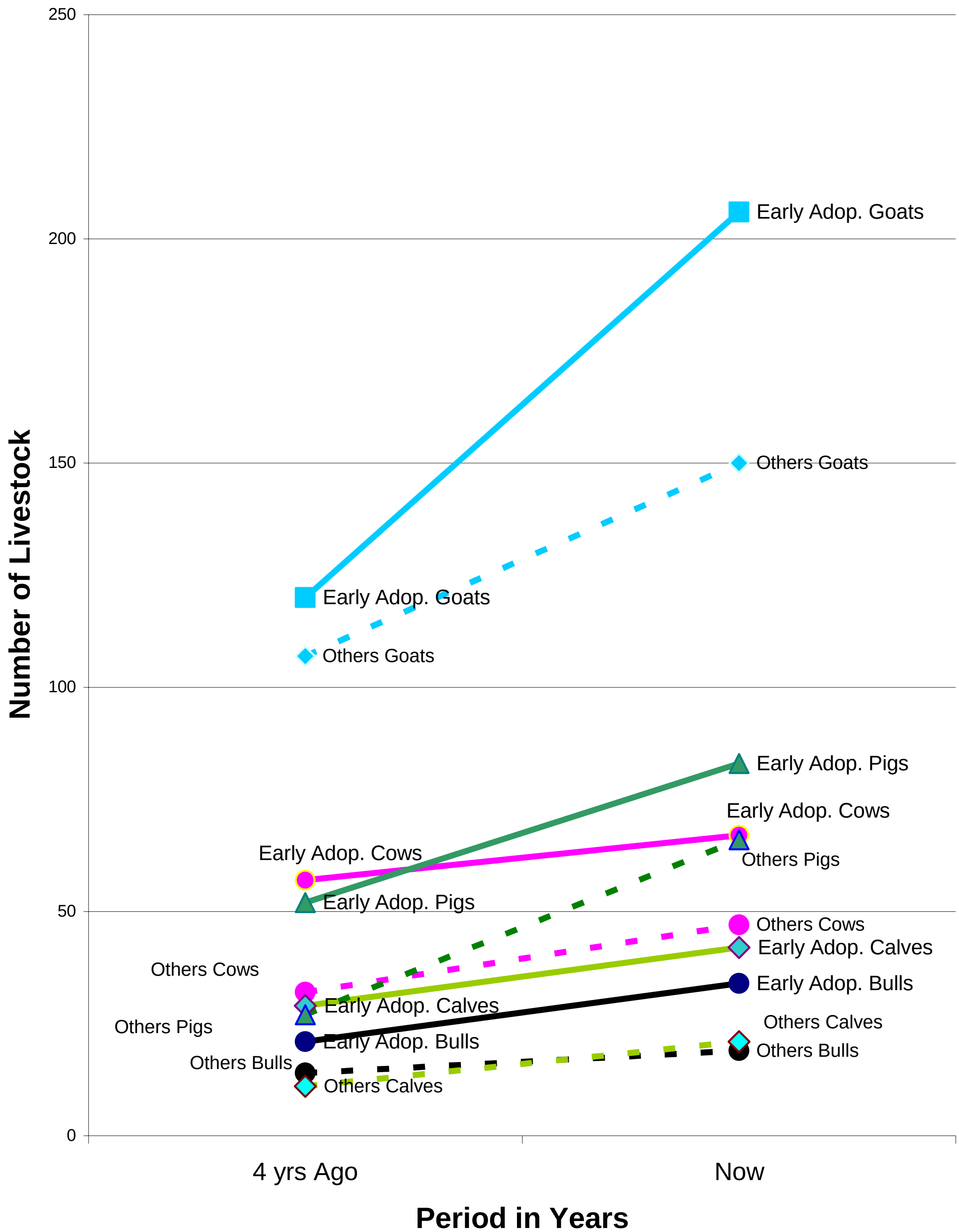


3.6 Changes in Assets

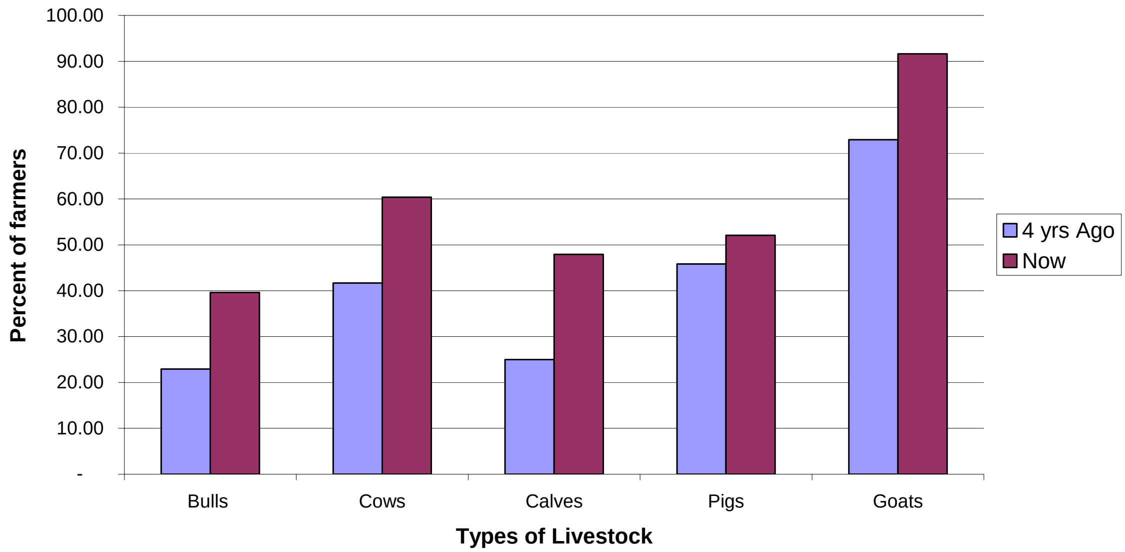
The acquisition or liquidation of assets is also a good indicator of the impact of a technology. Farmers in the two groups were asked how their asset holdings have changed between 2001, when they started adopting Catimor, and to date (2004). Both the 'Early Adopters' and the 'Other Farmers' showed a similar trend. Though more of the 'Early Adopters' had more of the mentioned assets than the 'Other Farmers', it is shown through Graph 18, on livestock, and 21, on other household assets, that the changes (acquisition of extra or liquidation) have been more all less the same for both groups. Both groups have acquired more assets in one group while less in another and also margins are almost the same. This is shown by the almost two parallel lines per set of asset such as calves, iron roof and radio.

In livestock, Graph 18, 'Early Adopters have acquired more goats and bulls than the 'Other Farmers' as shown by the diverging of the lines with time. On the other hand the 'Other Farmers' have acquired more pigs and cows. In terms of monetary value 'Early Adopters' on aggregate have acquired MK 388,491.51 while 'Other Farmers' have acquired MK 355,097.76 i.e. 'Early Adopters' have acquired more asset value through livestock than their counterparts. On distribution of the change in livestock it is seen that more 'Early Adopters' acquired cattle (bulls, cows and calves) and goats while more 'Other Farmers' acquired pigs than their counterparts as shown by the differences in percents Graph 19 and Graph 20).

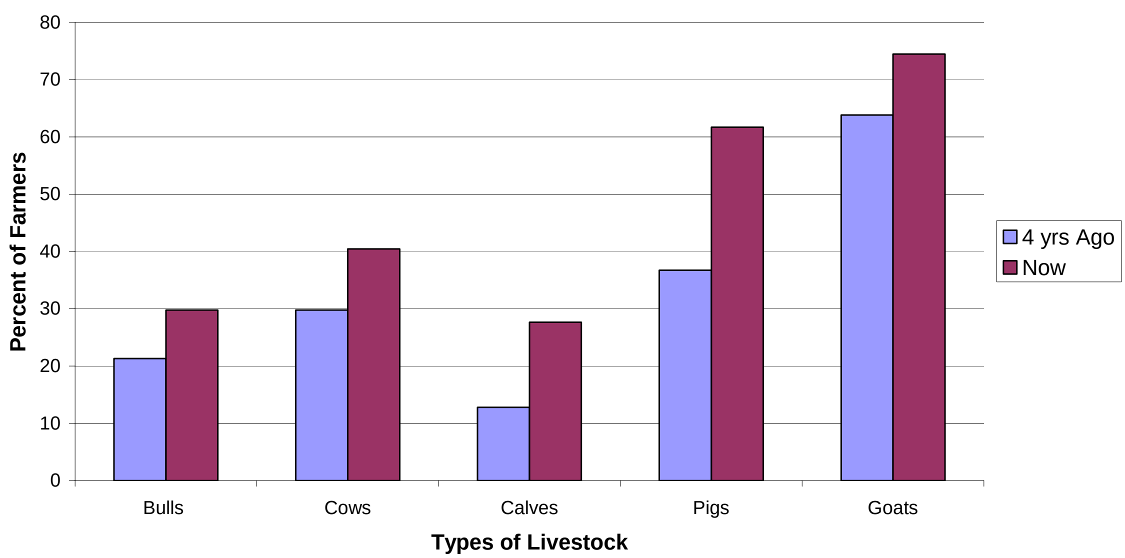
Graph 18: Trends of Total Livestock Held by Early Adopters or Other Farmers



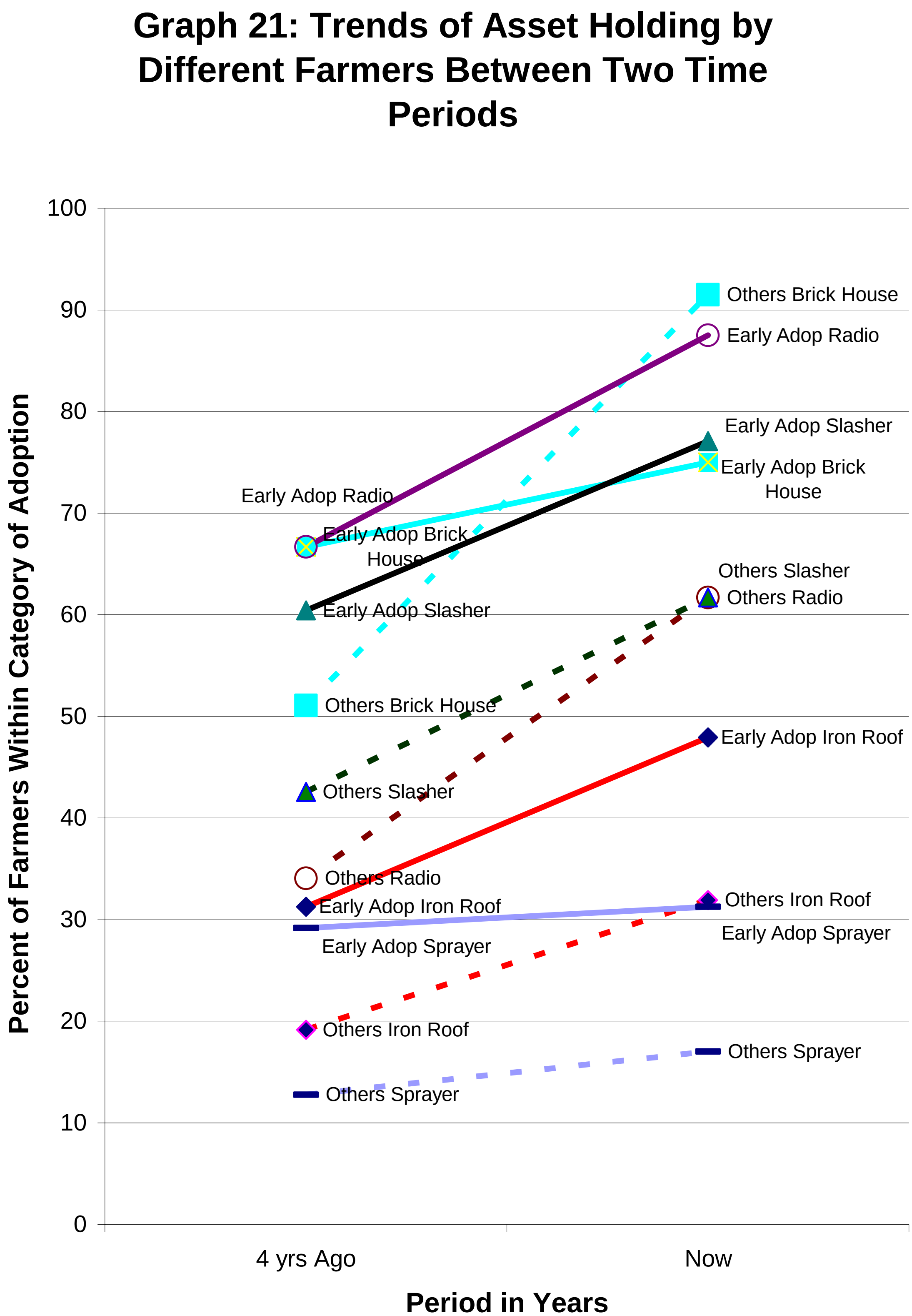
Graph 19: Percent of Early Adopters With Different Types Livestock Between Two Different Times



Graph 20: Percent of Other Farmers With Different Types of Livestock Between Two Different Times



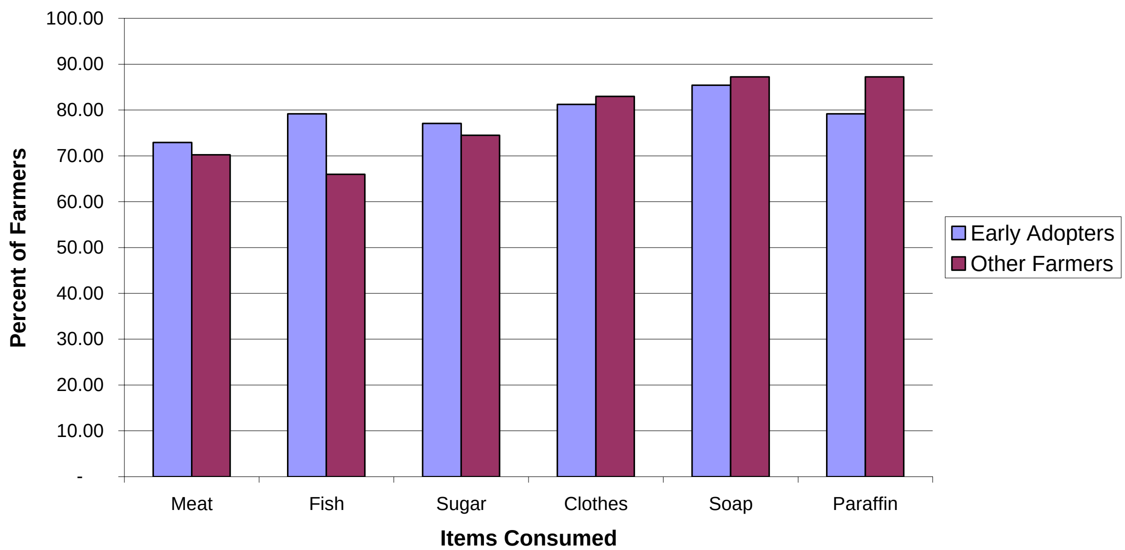
In other assets, more 'Early Adopters' have acquired iron roofs (17 versus 13 iron roofs) while more 'Other Farmers' have acquired the other assets i.e. 40, 28, 19 and 4 against 8, 21, 17 and 2 of brick houses, radios, slashers and sprayers respectively. In monetary value, 'Other Farmers' had more asset value acquired (MK 783,191.49 versus MK 756,666.67).



Graph 21: Trends of Asset Holding by Different Farmers Between Two Time Periods
Percent of Farmers Within Category of Adoption
100
90
80
70
60
50
40
30
20
10
0
4 yrs Ago
Now
Period in Years
Early Adop Radio
Early Adop Brick House
Early Adop Slasher
Others Brick House
Others Slasher
Others Radio
Early Adop Iron Roof
Early Adop Sprayer
Others Iron Roof
Others Sprayer
Others Brick House
Early Adop Radio
Early Adop Slasher
Early Adop Brick House
Others Slasher
Others Radio
Early Adop Iron Roof
Others Iron Roof
Early Adop Sprayer
Others Sprayer

From the above graphs it is seen that 'Early Adopters' are acquiring more long term assets than 'Other Farmers'. They have acquired more iron roofs while their counterparts just acquire the basic investments (sprayers, grass-thatched brick houses, sprayers, and radios). In the livestock also 'Early Adopters' have acquired more livestock. This means Catimor is showing some positive impact in asset change (acquisition).

Graph 22: Percent of Farmers Consuming More of the Different Items Between the Two Different Types of Farmers



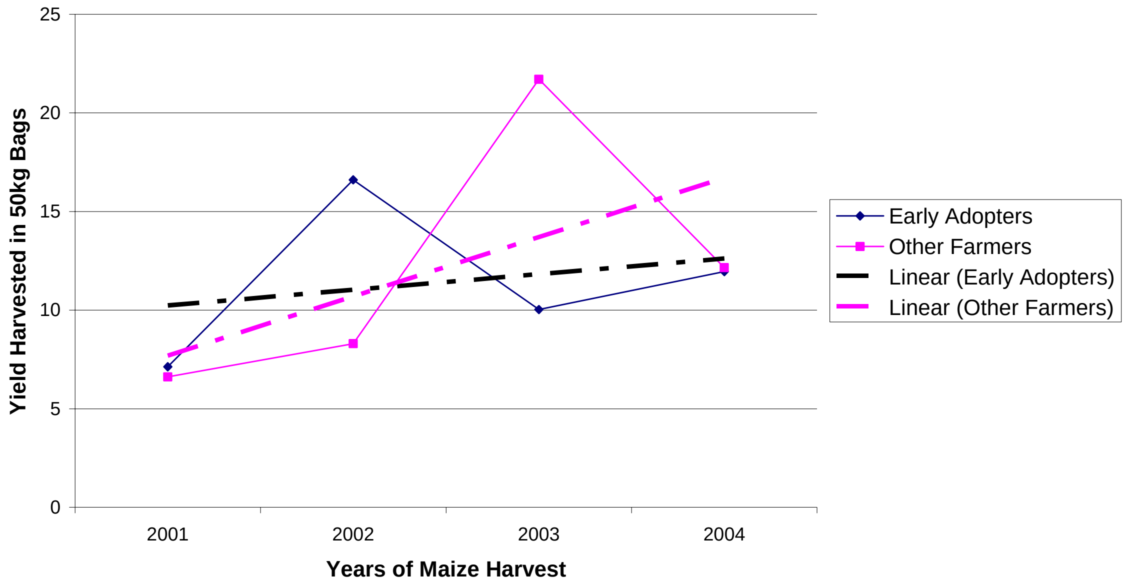
Graph 22 shows the consumption pattern of smaller consumable between the two types of households. It shows that more 'Early Adopters' were eating meat, fish, and sugar while more 'Other Farmers' consumed paraffin and only slightly more consumed clothes and soap. This consumption pattern shows a positive impact towards nutritional status since 'Early Adopters' dominated on the better food aspect.

3.6 Changes in household food security

Maize production

Introduction of Catimor has reintroduced the opportunity to obtain farm inputs such as fertilisers which farmers may use for maize production. Maize production was estimated through number of 50 kg harvested over the years. It should be pointed out that most farmers do not shell their maize into grain, but keep it unshelled. Linear trend in Graph 23 shows that 'Other Farmers' have increased their maize production more than the 'Early Adopters'. It should be noted, however that this increase in the Linear trend was brought about mainly by the good harvest of the year 2003 for the 'Other Farmers'. The true lines show that their patterns differ between years but come back to the same value. The trend however may mean that when the farmers start to plant Catimor the may initially increase their maize production but latter the maize production may come back to normal (same average number of bags per household).

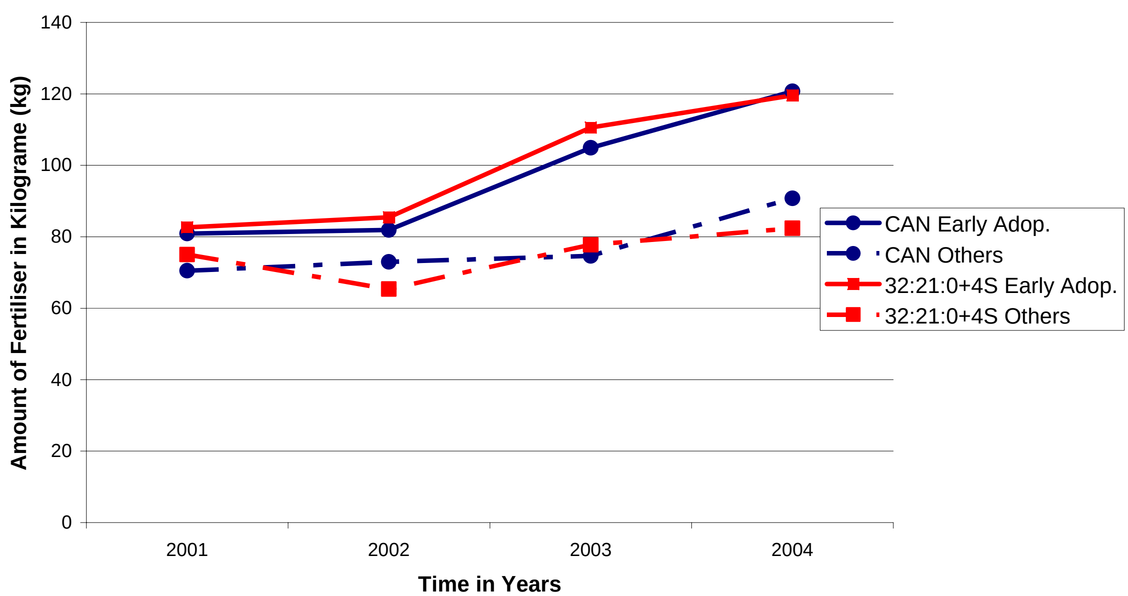
Graph 23: Trends in Maize Harvest Between Different Farmers



Fertiliser use in maize

The amounts of fertilisers applied in maize per farmer were higher for 'Early Adopters' than for 'Other Farmers'. 'Early Adopters' applied an average of about 120 kg of CAN and 120 kg of 23:21:0+4S while 'Other Farmers' applied 90 kg CAN and 83 kg

Graph 24: Trends in Fertiliser Use in Maize by Different Farmers



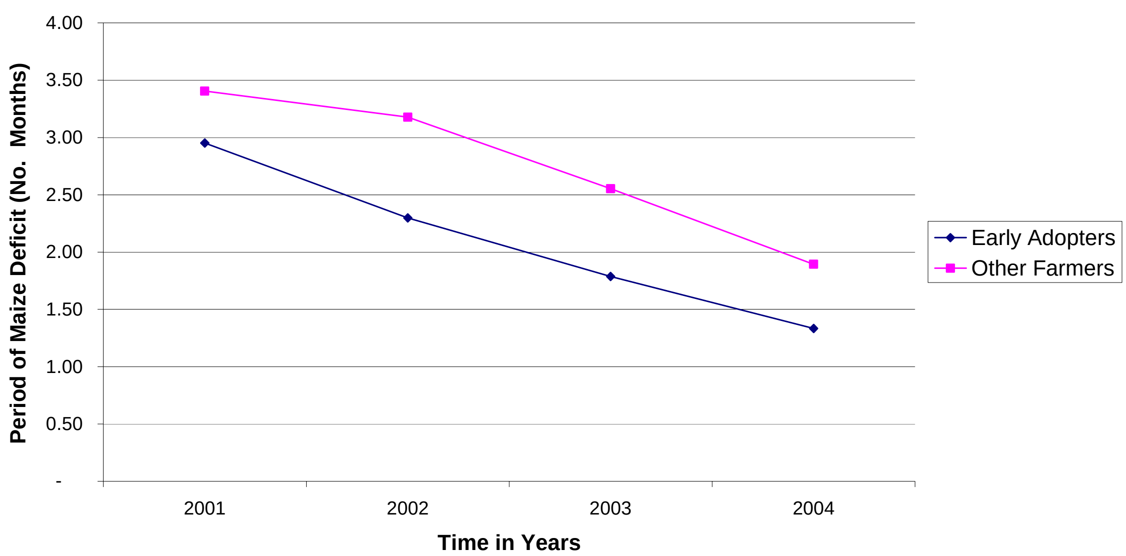
23:21:0+4S. Throughout since 2001 'Early Adopters' have been applying higher kilograms of fertilisers in maize than 'Other Farmers' (Graph 24). While the amounts of fertilisers have been increasing much more for the 'Early Adopters', the number of farmers receiving credit that has been increasing from the 'Other Farmers' point of view (Table 10). This means as the 'Other Farmers' adopted Catimor, their access to credit improved.

Table 10: Percent of Farmers That Have Been Obtaining Maize Fertiliser on Credit

	2001	2002	2003	2004
Early Adopters	85.42	87.50	93.75	91.67
Other Farmers	57.45	59.57	72.34	82.98

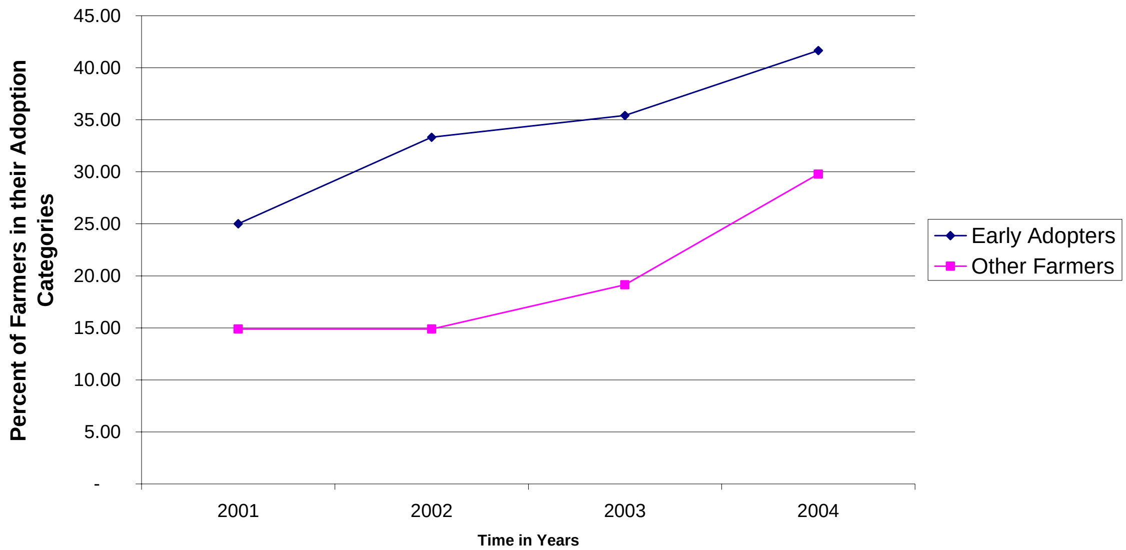
Graph 25 shows how the deficit period for the two types of farmers has changed since 2001. It is shown that the deficit period is smaller for the 'Early Adopters' than the 'Other Farmers'. However more interesting is the point that since 2002 when 'Other Farmers' started to adopt Catimor, and also when their fertiliser use also started to increase, the deficit line changes its shape by declining more sharply.

Graph 25: Trends of Maize Deficit (Food Insecurity) by Different Farmers



The maize secure households were also increasing security more sharply for the 'Other Farmers' as they planted more Catimor. Graph 26 shows that the line for 'Other Farmers had increased more sharply every year since 2002.

Graph 26:Percent of Maize Secure Households From the Different Farmer Groups



Input use for coffee in 2004

Results showed that in year 2004 about 92% of the coffee growing households in Misuku got coffee credit. Of these, 98% were 'Early Adopters' and 85% were 'Other Farmers' (Table 11). Those 'Early Adopters that did not get credit failed because they had defaulted paying back the credit in the previous years. In the 'Other Farmers' group 7% failed because of default problems, 4% bought using cash and another 4% did not qualify because they were classified as new growers.

Table 11: Got Coffee Credit in 2004

Type of Farmer	Percent that Got Credit
Early	97.92
Others	85.42
Total	92.63

The use of coffee inputs follows all the other characteristics more with 'Early Adopter' than 'Other Farmers' by a distinct margin.

Table 12. Input Use in Coffee in 2004

Input Fertilisers	Early Adopters		Other Farmers	
	No. of Units Used	% farmers that used	No. of Units Used	% farmers that used
J-Compound (10 kg)	45.2	52.08	45.5	22.92

Lime (10 kg)	10.0	2.08	20.0	2.08
CAN (50kg)	144.9	91.67	92.8	79.17
23:21:0+4S (50 kg)	136.3	87.50	85.5	77.08
Urea (50 kg)	50	2.08		
Manure	3 liters/Bush	2.08	-	
Pesticides				
Dursban (250 g)	1.9	50.00	1.4	31.91
Daconil (250 g)	1.3	12.50	1.5	8.51
Copper Oxychloride (500 g)	2.1	35.42	2.0	25.53
Fenitrothion (250 ml)	1.5	4.17	1.0	2.13
Lepas (5 kg)	-	-	-	-
Fungeran (500 g)	1.1	10.42	1.0	6.38
Teepol Sticker (200ml)	1.6	18.75	1.0	6.38
Others	-	-	-	-

3.8 Changes in labour use

This section tries to address the question of increasing labour requirement by growing Catimor. Table 12 shows that the number of households that increased the hiring of labour is indeed higher amongst 'Early Adopters' than the 'Other Farmers but the margin seems to be the normal margin all characteristics between the two types of households. The interesting part however is that more of the 'Other Farmers' have increased the use of hired labour in sweet potato. This is probably because the 'Other Farmers tend to diversify more than the 'Early Adopters'.

Table 13: Percent of Farmers That Have Increased Labour

Crop	**Early Adopters (% of HH)**	**Other Farmers (% of HH)**
Coffee	60.42	42.55
Maize	43.75	42.55
Beans	27.08	27.66
Sweet Potato	29.17	36.17

Table 13 tries to separate the major reasons that have lead to increased labour use amongst 'Early Adopters' versus 'Other Farmers'. It is clear from the percent of farmers responding to a particular reason that both 'Early Adopters' and 'Other Farmers' use of hired labour has grown because they have grown more coffee hence they want to catch up on time in doing other field operations.

Table14: Reasons for Labour Increase

Reasons for Increase	% Early Adopters	% Other Farmers
High demand in coffee activities (more coffee) 14	29.17	31.91
To do the field operations in time.	20.83	14.89
Expansion of coffee and crop diversification	8.33	6.34
Beans have a short season hence require helping hand.	4.17	
Because growing more Catimor	4.17	2.13
Coffee is More profitable	2.08	2.13
Sickness	2.08	0
Aged		8.51
No Husband		4.23

Table 15 shows that 'Other farmers' were paying relatively more than 'Early Adopters' for hired labour on the various tasks that they engage in managing their coffee. The percent of farmers that involved hired labour was however not very different. This shows that 'Other Farmers' are attaching a high value to Catimor as they are adopting it.

Table 15: Hiring Labor in Coffee

	Early Adopters				Other Farmers			
	% HH Using Ganyu	% HH Using Nyitira	% HH Using Fumilana	Average Cost (MK)	% HH Using Ganyu	% HH Using Nyitira	% HH Using Fumilana	Average Cost (MK)
Terracing	8.33	22.92	2.08	938.64	6.25	20.83	2.08	1,625.42
Trenching	8.33	31.25	8.33	894.62	10.42	8.33	4.17	1,492.86
Planting	0	4.17	2.08	0	2.08	2.08	6.25	350.00
Fertiliser Application	0	4.17	0		0	2.08	0	500.00
Pesticides	0	0	0	0	0	4.17	0	375.00
Weeding	10.42	8.33	2.08	985.71	10.42	8.33	2.08	1,168.89
Harvesting	12.50	33.33	8.33	1,849.44	2.08	31.25	4.17	1,196.92

Table 16 shows that 'Other Farmers' used children more for weeding than 'Early Adopters' while Early Adopters' use increased the participation of children and women more for harvesting than weeding. This agrees with the fact that 'Other Farmers' are most active in planting while 'Early Adopters' have started harvesting from their high yield new Catimor variety. The table also shows that almost all family members were actively contributing in harvesting for the 'Early Adopter' (5.04 persons per family)

Table 16: Participation of Labour in Coffee

Coffee Activity	Units of comparison	Early Adopters				Other Farmers			
		Men	Women	Children	Total	Men	Women	Children	Total
Weeding	Persons per HH	1.78	1.55	2.54	4.31	1.58	1.32	2.93	4.48
	% of HH with this labor	93.75	91.67	50	100	95.74	93.61	59.57	100
Harvesting	Persons per HH	1.76	1.57	2.76	5.04	1.51	1.3	2.82	4.63
	% of HH with this labor	93.75	95.83	68.75	100	95.74	97.87	70.21	100

Table 17: Perceptions of Farmers

Perceptions	Early Adopters	Other Farmers
Maximum Manageable Coffee (bushes)	3,402.22	2,633.02
Reduced Maize Area	27.08	29.79
Reduced Millet Area	22.92	21.28
Reduced Beans Area	22.92	29.79

Reduced Sweet Potato Area	27.08	27.66

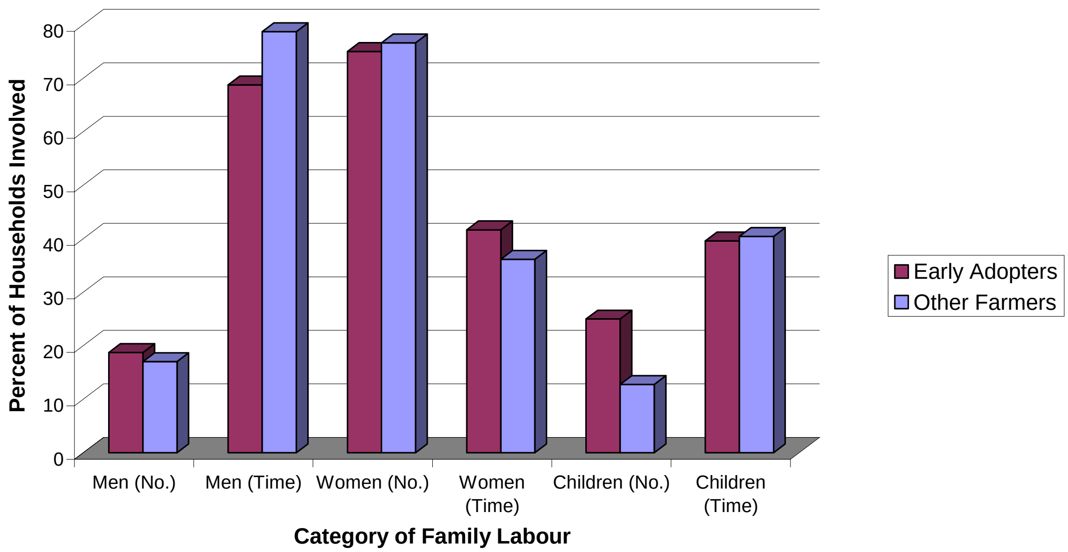
Table 18: Reasons for Area Reduction

Reason	Early Adopters	Other Farmers
I have more coffee bushes, hence spend more time on coffee than other crops.	22.92	17.02
To reduce pressure of work	8.33	4.26
To create space for planting coffee	6.25	0
Limited source of inputs	2.08	6.38
For planting another crop (cassava)	2.08	0
Age		6.38
Reduction in Family Labour		4.26
Crops not as profitable		4.26
Weather changes		2.13
Catimor is more labour demanding		2.13
N/A	60.42	59.57

Table 19. Reducing Time Spent on Off-Farm Activities

	Early Adopters	Other Farmers
Percent of Households that have reduced time	81.25	76.66
Reasons		
To spend more time on coffee	56.25	46.81
To concentrate on farming in general	10.42	14.89
Old age	4.17	4.26
Blanks	20.83	25.59
N/A	18.75	23.34

Graph 27: Increasing Family Labour Through Numbers or Time by Different Farmers



4.0 CONCLUSION

Results showed the socio-economic impact of Catimor was largely as expected with benefits reflected in higher income from coffee, increased ownership of assets, improved household food security, and multiplier effects through increased demand for hired labour. The livelihood impact of Catimor coffee, therefore, has been positive and this should help reduce poverty in northern Malawi, particularly in remote regions like Misuku Hills where few alternative livelihood strategies exist for households to earn cash income.

Results suggest that first Catimor adopters were drawn from households with less experience of coffee cultivation than others but with much higher levels of off-farm income from business enterprise. This income has allowed them to finance investment in high-input coffee technology and provided a financial cushion until that investment is repaid. In 2004, only the first fruits of that investment were visible. Consequently, household income among first adopters was not substantially higher than those who had planted later. However, income from coffee had risen and this was directly attributable to Catimor. Consequently, this group can expect to see significant increases in household income within the next 5 years.

Later adopters were characterised by a lower level of off-farm income that makes them less able to bear the cost of high-input technology and its associated risks. This increases their reliance on SCFT credit and the risk of default. Nevertheless, the results suggest that Catimor has had a beneficial impact on this group. The impact on household food security – made possible by SCFT credit – has been immediate, with a decline in maize deficits of 3 months. Income from coffee has also been used to strengthen the asset portfolio of these households, which has reduced their vulnerability to shocks, and to finance investments in human capital (health, schooling) as well as in basic needs like clothing. So far, income from Catimor among this group has been insufficient to finance livelihood diversification into higher-paying forms of off-farm enterprise. Hence, they remain highly dependent on the success of Catimor for cash income in the future.

Investment in Catimor has come at a price for other sources of farm income. In particular, early adopters have experienced a sharp fall in income from banana as a result of the recommendation to plant in pure stand. Banana is the single-most important cash crop after coffee. This underlines the importance of our OFTs with coffee -banana intercropping. Allowing Catimor to be intercropped with banana is likely to encourage adoption among poorer farmers for whom this is an important source of cash income. Expanded planting of coffee has also resulted in reduced areas planted to low value staples like millet, and to crops like beans and sweet potato that are a source of income for women. This may have disadvantaged women. However, it is likely to have been compensated by crop diversification into coffee. In male-headed households, women have chosen to plant Catimor in order to provide them with an independent source of income.

Finally, the multiplier effects from Catimor are significant. There are positive backward linkages with transport and local manufacturing through the purchase of fertiliser and pesticides. There are also forward linkages through increased investment (house-building) and consumption (retailing). There are also important impacts on the labour market. Catimor has increased the demand for hired labour, particularly in land reparation, weeding and harvesting. This demand has been met locally through group labour, benefiting those who may not have benefited directly from coffee.

PROJECT R8204 [FTR Part4]
APPENDIX 4: Working Paper A1063/4

Farmer and Economic Evaluation of Insecticide for Coffee Stem Borer, Malawi

January, 2005

A W Orr

Natural Resources Institute, University of Greenwich, UK

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Summary

Control of white stem borer (WSB) in Malawi using chemical stem paint (Fipronil) was evaluated for effectiveness by farmers and for its economic benefits over the 8-year life-cycle of Catimor coffee.

A farmer evaluation of two on-farm demonstration plots concluded that Fipronil was effective in controlling WSB. Farmers also considered chemical control more effective against WSB than their traditional strategy of bark-smoothing. However, none of the farmers who participated in the evaluation was prepared to pay more than 3 MK/tree for chemical stem paint.

An economic evaluation of WSB control using stem paint showed that economic returns from the technology were lower than using no treatment at all, when net benefits were discounted over the 8-year life cycle of Catimor coffee. At a 15 % discount rate, the Net Present Value (NPV) for Fipronil was 153,002 MK/ha compared to 243,935 MK/ha without Fipronil. Thus, the NPV of the control was 37 % higher than that of the experimental treatment. This reflected the relatively high cost of chemical paint as well as the scarcity of working capital in smallholder agriculture.

This economic evaluation is provisional since full information on WSB infestation rates is not yet available. Changing the technical assumptions (eg. assuming higher Catimor yields) would result in higher returns from chemical control of WSB. However, the determining factor for adoption of chemical control is likely to be the relatively high cost of this strategy for resource-poor coffee growers. Efforts to reduce the cost of this technology are needed to make it more attractive to farmers. At the same time, researchers should continue the search for alternative IPM strategies that deliver effective control at lower cost.

Introduction

Control measures for White Stem Borer (WSB) are currently being tested in on-farm trials (OFTs) on 16 farms in four districts in in coffee-growing areas of northern Malawi. Treatments include wood ash and two insecticides (Fipronil and Imidacloprid) began in October 2001. Fipronil ("Regent") was "partially approved" by the Agricultural Technology Clearing Committee (chaired by Prof. Vincent Saka) for use in OFTs. More data was required for "full approval" and its official release for use on coffee. This data will be provided after three season's trials (2002-3, 2003-4, and 2004-5). Partial approval has also been obtained for use of Imadacloprid ("Confidor"). The Smallholder Coffee Farmers Trust (SCFT) began demonstrations of insecticides for Coffee Stem Borer in 2002. Because of the high cost of Imadacloprid (200 MK/tree), Fipronil was used as the insecticide treatment on SCFT demonstration plots..

This report presents an evaluation of Fipronil treatment against WSB from two perspectives. The first is a farmer evaluation of two demonstrations mounted by the SCFT. The second is an economic evaluation based on best-available data. A full evaluation was not possible since accurate information on the pattern of WSB infestation is not yet available. The results reported here are preliminary and based on information available at the time of writing.

The Coffee Stem Borer

The adult white stem borer (*Monochamus leuconotus*) lays eggs on the stem in December after the onset of the rains and the larvae hatch in January-February, after which they bore into the tree. Their presence may be detected by frass at the base of the tree, "ring-barking" as the larvae moves down the outside of the stem, and an entry-hole as it enters the stem. The larva feeds inside the stem on water and nutrients taken from the young coffee plant. Leaves on the coffee bush will curl and turn yellow, and bearing is reduced. After one year the larvae become adult and exit through another hole. By this time a young tree will be dead but older, well-managed trees will survive. WSB won't attack one-year old bushes because the stem is too thin to house the borer. The pest prefers young coffee (two years and over) because the stem is still soft and tender.

Farmer Evaluation of On-Farm Trials

A short farmer evaluation of WSB control using stem paint was made to complement a formal economic evaluation. Four SCFT Demonstrations were used to demonstrate the technology, of which two were suggested as most appropriate for farmer evaluation by Dr. Hillocks (NRI) and Dr. Oduor (CABI-Nairobi). We arranged meetings with farmers to evaluate the use of Fipronil paint at these demonstrations.

Process

The demonstration is laid out in 2-3 hedgerows of three-year old Catimor coffee. Ten trees were painted to knee-height with Fipronil in September 2002. Since the treated trees are scattered randomly in the hedgerow, they were marked with white paper to make them easy for farmers to identify. Farmers were asked to inspect each of the treated trees for evidence of WSB. "Evidence" was defined to mean not just entry holes for WSB, indicating that larvae were inside the tree causing damage, but also evidence of frass or ring-barking. We then held a discussion on the trial, focusing on the effectiveness of the treatment, farmers' own control strategy, and the price that farmers would find acceptable for stem painting with Fipronil.

Participating farmers

1. Katowo

No	Farmers present	Bearing trees	Young coffee	Attended demo ? (Yes/No)
1	Wad Chayunga	2500	1400	Yes
2	Mpoya Sirumbo	1500	1200	Yes
3	Ms Glydness Sirumbo	1000	1000	Yes
4	Synet Mbuyo *	3000	2000	Yes

2. Kakomo

No	Farmers present	Bearing trees	Young coffee	Attended demo ? (Yes/No)
1	Ephraim Chirongo	1700	500	Yes
2	Serenje Mukumba	700	500	No
3	Dickson Misuku	940	65	Yes
4	Green Misuku	1000	700	Yes
5	Ken Kuyokwa	500	350	Yes
6	Lenwell Chirongo	700	200	Yes
7	Philip Kuyokwa *	800	600	Yes
8	Webster Kuweta	300	600	Yes
9	Osten Simaye	0	500	Yes

* Owner of field where demo was located.

Effectiveness

In Katowo, farmers found one out 10 trees affected by WSB, evidenced by frass, but found no ring-barking or entry hole. They concluded that "the beetle had attacked but gone away". They concluded that Fipronil was effective.

Farmers' strategies

Farmers' used bark smoothing (in ChiNdale, *kupiata*) to prevent the adult laying eggs on the stem. This was done to trees in their second year, because in the first year stems were too thin to allow access by the WSB. Smoothing was done with a knife, or a maize cob, or a sack. Ideally, smoothing is done twice, first in September-November when adult beetles were visible, and second in January-March after the rains, when the tree grows. The second smoothing coincides with first weeding. Women weeded while men smoothed the bark. Because vigorous smoothing might damage the tree, farmers did not use hired labour (*nyitira*) for this task, and only used family labour aged 16 and over, not children. If farmers saw larvae while smoothing, or saw an entry hole, they would use a grass stem or stick to kill the larvae in the hole. Smoothing needed only one minute per tree (three minutes if they found and killed larvae), and was reported to be an effective strategy.

Asked why they might prefer stem-painting to bark smoothing, farmers replied that; (1) smoothing might damage the tree, especially if a knife was used (2) smoothing was not effective for a long time, like Fipronil. Usually smoothing lasted a month, and had to be done a second time in January or February after the rains. With pressure of work, however, they might not manage to smooth two times a year. Three farmers claimed they did while a fourth (the lady) said that she could not manage. Finally (3) farmers believed that “chemicals” were more effective than other methods of control.

Cost of Fipronil

In Katowo, two farmers said they would pay 2 MK/tree, one said 3 MK/tree, and one said 5 MK/tree. In Kakomo, we asked farmers to “vote” for the maximim price they would pay for Fipronil. Results showed that all farmers (9) would pay 2 MK/tree, and all would pay 3 MK/tree if this gave protection for two years. None was willing to pay more than Mk 3/tree.

ChiNdale vocubulary

The relevant ChiNdale words farmers used in discussing WSB are given below:

Chindale	English
Mbena	Larva
Nanipembe	Adult beetle
Uwashi	Entry hole
Benyekesha	Frass
Kupekesa	Ring-barking
Kuswinana	Curled leaf (symptom of WSB damage)
Kupiata	Bark-smoothing

Economic evaluation

Infestation rates for WSB

Two sources of information were available.

1. Results from OFTs show that between October 2001 and May 2003 mean infestation rates (all sites) averaged 0.06 plants (Fipronil), 1.92 (wood ash) and 2.44 (control). (Oduor, 2004). This shows 49 % infestation over 3 seasons or 16% per annum. This is high because the plots already contained WSB. Starting with a clean field but with WSB infected trees in the neighbourhood the infestation would follow a typical logistic “S” curve with a slow start, going exponential after a certain critical mass in terms of numbers of infested trees, and then flattening out as it gets harder to locate un-infested trees. To determine this curve, data would be needed showing the

number of infested trees each year from the time a new garden is planted out until it is grubbed out for replanting. This data was not available.

2. Results from the CFC Biological Control Survey in 2002 which sampled 840 farms in 10 districts show an average incidence of 33 % for Misuku Hills (Gondwe, 2004).

In the absence of other data, we assumed that, for untreated plots (ie. the control), 30 % incidence represented the maximum infestation rate. We then interpolated a hypothetical logistic curve to show growth in infestation reaching 30 % over an eight year period. For the treatment plot (ie,,plants treated with stem paint)we interpolated a logistic curve as follows:

Year	1	2	3	4	5	6	7	8
rate/5 plants	0	0	0.06	0.12	0.24	0.48	0.49	0.5
Mean %	0	0	1	2	5	10	11	12

Costs and returns for Catimor coffee

To estimate costs and returns for Catimor, we used the level of inputs recommended by the SCFT. Table 1 shows the physical input requirements for Catimor, which vary by year of planting. Table 2 shows the cost of these inputs, based on 2004 SCFT prices. Based on these quantities and values, Table 3 shows estimated unit costs of production for Catimor based on a planting density of 5555 trees/ha.

These estimates obviously require several technical assumptions about coffee yields, the frequency of applying stem paint, and the rate of infestation, all of which may be questioned. We have used the assumptions that seem most plausible, but it is important to note that assumptions may change as better data becomes available. For example, it may turn out not to be necessary to apply stem paint every year. Changes in any one of these assumptions would alter the results of an economic evaluation of this control strategy for WSB..

4. Net present values

Tables 4 and 5 present costs and returns for the experiment and control treatments over a period of 8 years, the expected lifetime for Catimor. Two cost and returns streams were estimated. Cash-costs include only the cost of purchased inputs, excluding labour. Full-costs include both the costs of cash inputs and of labour, which was valued at the full market rate.

To compare profitability, we compared net present values (NPVs) for these treatments at two discount rates (10 % and 15 %). Results in the text table below show, based on the assumptions made in this analysis, control of WSB through chemical stem paint was not economic given current prices. This was true at both discount rates. This was also true even when NPVs were measured on a cash cost basis, excluding the cost of labour. At a 15 % discount rate, the NPV for Fipronil was 153,002 MK/ha compared to 243,935 MK/ha without Fipronil. Thus, the NPV of the control was 37 % higher than that of the experimental treatment.

The lower NPV for chemical control reflects the relatively high cost of this technology and the scarcity of capital in smallholder agriculture, which is reflected in a high discount rate.

Discount factor	10 %	15 %
Investment in Fipronil (MK/ha)		
Cash-cost basis	221,887	153,002
Full-cost basis	103,855	59,013
No investment in Fipronil (Mk/ha)		
Cash-cost basis	312,785	243,935
Full-cost basis	220,230	175,305

Conclusion

Farmer evaluation of chemical control for WSB was positive, suggesting that this IPM strategy was recognised to be effective and superior to farmers' existing strategy of bark-smoothing. Farmers were not aware of the cost of chemical control, however. They indicated that there was a limit to what they were prepared to pay for this technology, however effective. This limit was 3 MK/tree, which was approximately half the estimated cost of chemical control in current on-farm trials.

Economic evaluation of chemical control for WSB is necessarily provisional because full information on WSB infestation rates is not yet available. Moreover, the technical assumptions of the analysis may be challenged. Changing these assumptions would improve the economic returns from chemical control. On the other hand, some might argue that the choice of a 15 % discount rate is unreasonably low and biases the evaluation in favour of chemical control. A higher discount rate – say 20% - would lower the economic return from chemical control.

The determining factor for adoption of chemical control is likely to be the relatively high cost of this strategy for resource-poor coffee growers. Efforts to reduce the cost of this technology are needed to make it more attractive to farmers. At the same time, researchers should continue the search for alternative IPM strategies that deliver effective control at lower cost.

References

J. Biscoe (2003).Report of the Short-Term External Consultancy in Coffee Husbandry. SCFT. Mimeo, 82 pp.

C. Chanika (2004). Fertiliser use on Catimors, in R. Hillocks, Editor, Promotion of IPM for Smallholder Coffee In Malawi, Proceedings of a Project Workshop, Mzuzu, 25 May, 2004. Chatham: Natural Resources Institute. Mimeo.

F. Gondwe (2004). Socio-economic issues in Coffee WSB Management, in R. Hillocks, Editor, Promotion of IPM for Smallholder Coffee In Malawi, Proceedings of a Project Workshop, Mzuzu, 25 May, 2004. Chatham: Natural Resources Institute. Mimeo.

G. Oduor (2004). Review of CFC WSB Project, in R. Hillocks, Editor, Promotion of IPM for Smallholder Coffee In Malawi, Proceedings of a Project Workshop, Mzuzu, 25 May, 2004. Chatham: Natural Resources Institute. Mimeo.

SCFT (2004). Gross Margin Analysis.

Table 1. Recommended input requirements for Catimor coffee (per ha)

Input	Units	Applications/year	Planting	Year 1	Year 2	Year 3-8
Fipronil (“Regent)	Litre	One	60 mls/tree	60mls/tree	60 mls/tree	60 mls/tree
Fertiliser (kg/ha)						
Single super phosphate	Kg	One	400			
23: 21 +4 S	Kg	One		140	280	560
CAN	Kg	One		140	280	560
J. Compound	Kg	One		Nil	280	560
Chemicals (kg/ha)						
Dursban	Litres	Three				4.5
Daconil	Kg	Five				12.5
Copper oxychloride	Kg	Five				25
Labour	Days/ha (8 hours)					
Applying Fipronil	Days/ha	Once	25	25	25	25
Weeding, 10 days	Days/ha	Two	20	20	20	20
Harvesting @ 44 kg/day	Kg/cherry/day	One	Varies by yield			
Transport to pulpery, @ 25 kg/trip, 2 hours/trip, 4 trips/day	Days/ha	Four	Varies by yield			
Insecticide (Dursban) spraying 1.6 days/round	Days/ha	Three		5	5	5
Fungicide (Daconil and Copper) spraying 6.6 days/round	Days/ha	Five		33	33	33
Lime application, 4 days	Days/ha	One	4			
Fertiliser application, 4 days	Days/ha	Two (Yr 1) Three (Yr 2 +)		8	12	12
Total labour days/ha	Days/ha					

1. Fertilisers, Chanika (2004).
2. Chemicals, SCFT Schedule 1-iv.
3. Labour, Biscoe (2003)
4. Assumes labour of 2 minutes/tree.
5. Firpronil (“Regent”) retail price 20,764 MK/litre (June, 2003). Estimates are based on cost of 20,000 MK/litre. One litre diluted in 200 litres of water. Each tree requires 60 ml of diluted paint. This gives cost/tree of 6 MK (200 litres diluted paint x 1000 mls, divided by 60 mls/tree, divided by 20,000 Mk/litre).

Table 2. Cost of recommended inputs for Catimor coffee (MK/ha)

Input	Unit	Cost/unit	Planting	Year 1	Year 2	Year 3-8
Firponil (“Regent”)	Litre	20,000	33330	33330	33330	33330
Fertiliser						
Single super phosphate	50 kg bag	250 (2003)	2000			
23: 21 +4 S	50 kg bag	2162 (2004)		6054	12107	24214
CAN	50 kg bag	1614 (2004)		4519	9038	18077
J. Compound	50 kg bag	1500 (2003)		Nil	8400	16800
Total fertiliser (MK/ha)			2000	10573	29545	59091
Chemicals						
Dursban	1 litre	2000 (2004)				4500
Daconil	1 kg	1040 (2004)				13000
Copper oxychloride	1 kg	330 (2004)				8250
Total chemicals (MK/ha)			0	0	0	25750
Total cash costs (MK/ha)			35330			
Labour						
Applying Fipronil	Mk/day	40	1000	1000	1000	1000
Weeding, 10 days	MK/day	40		800	800	800
Harvesting @ 44 kg/day	MK/day	40	Varies by yield			
Carrying to pulpery, @ 25 kg/trip, 2 hours/trip	MK/day	40	Varies by yield			
Insecticide (Dursban) spraying 1.6 days/round	MK/day	40				200
Fungicide (Daconil and Copper) spraying 6.6 days/round	MK/day	40				1320
Lime application, 4 days	MK/day	40	160			
Fertiliser application, 4 days	MK/day	40	0	320	480	480
Total labour days/ha						
Without harvesting/carrying	Mk/ha		160	1120	1280	2800

Table 3. Unit costs of production (per ha, 5555 trees)

Variable	Planting	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Total
Number of trees planted	5555									
Fipronil	33330	33330	33330	33330	33330	33330	33330	33330	33330	
Fertiliser	2000	10573	29545	59091	59091	59091	59091	59091	59091	
Chemicals	0	0	0	25750	25750	25750	25750	25750	25750	
Labour for applying paint	1000	1000	1000	1000	1000	1000	1000	1000	1000	
Other labour	160	1120	1280	2800	2800	2800	2800	2800	2800	

Table 4. Costs and returns for investment in stem paint (Fipronil) (MK/ha)

Variable	Planting	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Total
Infestation rate (%)	0	0	0	1	3	5	10	11	12	
Trees surviving (no)		5555	5555	5500	5388	5277	5000	4944	4888	
Costs that vary										
Fipronil	33330	33330	33330	33000	32328	31662	30000	29664	29328	285972
Fertiliser	2000	10573	29545	59091	59091	59091	59091	59091	59091	396664
Chemicals	0	0	0	25750	25750	25750	25750	25750	25750	154500
Total cash costs	35330	43903	62875	117841	117169	116503	114841	114505	114169	837136
Labour for applying paint	0	1000	1000	1000	1000	1000	1000	1000	1000	9000
Harvesting costs	0	0	0	10000	24491	23986	22727	22473	13331	117008
Carrying costs	0	0	0	4400	10776	10554	10000	9888	5866	51484
Other labour costs	160	1120	1280	2800	2800	2800	2800	2800	2800	19360
Total labour costs	160	2120	2280	18200	39067	38340	36527	36161	22997	196852
Full costs (cash +labour)	35490	46023	65155	136041	156236	154843	151368	150666	137166	1032988
Benefits										
Yield/tree (kg cherry)		0	0	2	5	5	5	5	3	
Production (kg/cherry)				11000	26940	26385	25000	24720	14664	
Price (MK/kg/cherry)		10	10	10	10	10	10	10	10	
Gross benefits		0	0	110000	269400	263850	250000	247200	146640	1287090
Net benefits										
Cash-cost basis	-35330	-43903	-62875	--7841	152231	147347	135159	132695	32471	448954
Full-cost basis	-35490	-46023	-65155	-26041	113164	109007	98632	96534	9474	252102

Table 5. Costs and returns for control treatment (no stem paint) (MK/ha)

Variable	Planting	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Total
Infestation rate (%)	0	0	0	1	10	20	25	27	30	
Trees surviving (no).	5555	5555	5555	5500	5000	4444	4166	4055	3889	
Costs that vary										
Fertiliser	2000	10573	29545	59091	59091	59091	59091	59091	59091	396664
Chemicals	0	0	0	25750	25750	25750	25750	25750	25750	154500
Total cash costs	2000	10573	29545	84841	84841	84841	84841	84841	84841	551164
Harvesting costs		0	0	10000	22727	20200	18936	18432	9243	99538
Carrying costs		0	0	4400	10000	8888	8332	8110	4067	43797
Other labour costs	160	1120	1280	2800	2800	2800	2800	2800	2800	19360
Total labour costs	160	1120	1280	17200	35527	31888	30068	29342	16110	162695
Total costs (cash+labour)	2160	11693	30825	102041	120368	116729	114909	114183	100951	713859
Benefits										
Yield/tree (kg cherry)		0	0	2	5	5	5	5	3	
Production (kg/cherry)				11000	25000	22220	20830	20275	10167	
Price (MK/kg/cherry)		10	10	10	10	10	10	10	10	
Gross benefits		0	0	110000	250000	222200	208300	202750	101670	1094920
Net benefits										
Cash-cost basis	-2000	-10573	-29545	25159	165159	127359	123459	117909	16829	533756
Full-cost basis	-2160	-11693	-30825	7959	129632	105471	93391	88567	719	381061