Alternative Land Use Options in the Mount Cameroon Region: An Economic Analysis

A report prepared for the Mount Cameroon Project and Department for International Development

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Contents

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Areas referred to in this study

Area A:	Mabeta and Bimbia
Area B:	West Coast, Debundscha & Etinde
Area C:	Idenau, Bomana Corridor & Lower Onge Basin
Area D:	Boa Plain, Iloani, Mokoko and Middle Onge Basin
Area E:	Bakweri Upper Villages & Tole

Executive Summary

This report presents the findings of a DFID-funded study into the costs and benefits of alternative land use options in forested lowland of the Mount Cameroon Region.

The aim is to consider the financial and broader economic returns to oil palm and rubber plantations, sustainable forest use and subsistence oriented agriculture (chop-farms). We have made a particular effort to compare the returns from possible expansion by the Cameroon Development Corporation (CamDev) with alternative options in each of the five areas identified in the recent draft environmental impact assessment - ERM (1997).

The methodology that we use is to calculate total economic values for various land uses. Hence for Chop farms, oil palm and rubber plantations and sustainable forest use we consider:

Direct use values	• net returns to crop production, plantation agriculture and sustainable timber use; • net values of non-timber forest products (NTFPs); and • net returns to Prunus africana use
Indirect use values	• carbon storage; • undiscovered plant-based drugs; • flood protection; and • preventing sedimentation of ground water;
Option & non-use values	• option, existence and bequest values

Values are estimated in both financial and economic terms with the former being most useful when we consider returns at the level of farmers, CamDev or timber companies. However, none of the conclusions change when the analysis is undertaken in financial terms. Note that as current exchange rates between The Pound and CFA Franc are close to 1:1000, all figures can be read as £/ha or CFAF 000/ha.

The Tables on the following pages set out the total economic value for alternative ways of using CamDev leasehold land that they currently do not utilise. For ease of comparison across areas, results are presented as per hectare figures. The key results are that:

- the expansion of oil palm and rubber plantation is **not** justified in financial or economic terms in any of the areas concerned. For example, The international price of palm oil would need to rise 64% for the potential 9000 ha expansion in Boa Plain and Iloani to be viable;
- sustainable use of the forest is both financially and economically viable. The major benefits are derived from indirect use, particularly carbon storage. The financial benefits that accrue directly to local communities (as tax revenue and non-timber forest products) from sustainable forest use are likely to be small in comparison. An exception to this occurs in those villages able to harvest Prunus africana. In the Upper Villages area, for example, the financial returns to P.

africana appear to be rather greater than those from sustainable timber use and all other non-timber forest products combined.

- the **economic** values calculated for P. africana are necessarily tentative given the limited data available. Yet it is clear these are significantly greater than the net financial returns. Under plausible assumptions the discounted net economic returns may be as high as £2,900 per hectare for the Upper villages. In this case, the sustained use of forest land containing P. africana is far more valuable to the world in general than conversion to agriculture or plantations. This is not perceived at the village level as there is a huge gap between the economic returns (based on the international export value of the bark extract) and the financial returns earned by those who collect the bark. Hence where there is direct competition for land, the financial returns to local people from P. africana are lower than the financial returns to chop farming.
- If no constraint is placed on small-scale (chop) farming, the economic returns that can be earned exceed those obtained from sustainable forest use. However, current agricultural practices are not sustainable and, once allowance is made for this, the economic return to chop farming is less than that which accrues to the forest.
- More work is needed to identify which forms of sustainable farming are most appropriate for the MCP area and which groups of farmers are most likely to switch to new technologies. In addition to positive incentives, there may be scope for CDC to apply leverage to farmers on their land (some 20% of all chop farms) to adopt improved farming practices. Restrictions on where inward migrants (principally from Nigeria and NW Cameroon) can start new farms may also need to be considered.
- A more optimistic valuation of environmental benefits such as carbon storage (or a lower discount rate) further shifts the economic argument in favour of the forest. Yet it has to be stressed that the financial incentives faced by farmers on the ground do not reflect this and donor support will be necessary to ensure the economic benefits of sustainable forest use are realised.
- non-use (option, existence and bequest) values comprise a modest proportion of total economic value of the forest. If the value attached to preserving endangered species and prized habitats in the industrialised world were to apply to preserving biodiversity in the project area the economic return to the forest would be much higher. Unfortunately, the highest non-use values we can justify are based on current international and local expenditure to protect the forest resource. This expenditure is both significant in absolute terms and is consistent with estimates of non-use values for tropical forest in the environmental economics literature. In per hectare terms, however, such values are small.

Area A: Mabeta and Bimbia

Base-case – economic values - net present values per hectare at 10% discount rate			
	Forest maintained £/ha	conversion to oil palm £/ha	Conversion to chop farms £/ha
Direct use value (timber, oil palm or chop farm)	226	(2,882)	1,047
NTFPs	26	6	18
Carbon storage value	1,391	487	420
Undiscovered plant-based drugs	1.4		
Flood prevention	0		
Preventing sedimentation	8		
Non-use value (option, bequest, existence)	62		
Total	1,715	(2,389)	1,485

Area B: West Coast, Debundscha & Etinde

Base-case – economic values - net present values per hectare at 10% discount rate			
	Forest maintained £/ha	conversion to oil palm £/ha	Conversion to chop farms £/ha
Direct use value (timber, oil palm or chop farm)	214	(2,352)	1,004
NTFPs	43	11	28
Carbon storage value	1,501	765	420
Undiscovered plant-based drugs	2		
Flood prevention	126		
Preventing sedimentation	7		
Non-use value (option, bequest, existence)	62		
Total	1,955	(1,576)	1,452

Area C: Idenau, Bomana Corridor & Lower Onge Basin

Base-case - economic values - net present values per hectare at 10% discount rate			
	Forest maintained £/ha	Conversion to oil palm £/ha	Conversion to chop farms £/ha
Direct use value - timber or chop farms	287	(694)	1,230
Direct use value - NTFPs	37	6	23
Direct use value - Prunus africana	1,193	0	0
Carbon storage value	1,501	(637)	387
Undiscovered plant-based drugs	2		
Flood prevention	143		
Preventing sedimentation	11		
Non-use value (option, bequest, existence)	62		
Total	3,236	(1,326)	1,640

Area D: Boa Plain, Iloani, Mokoko and Middle Onge Basin

Base-case - economic values - net present values per hectare at 10% discount rate			
	Forest Maintained npv/ha CFAF 000	Conversion to oil palm + rubber Npv/ha CFAF 000	Conversion to chop farms CFAF 000
Direct use value (timber, oil palm or chop farm)	292	(1,871)	68
NTFPs	37	6	23
Loss of carbon storage	1,321	777	387
Undiscovered plant-based drugs	2	0	
Flood prevention	168	0	
Preventing sedimentation	3	0	
Non-use value (option, bequest, existence)	62	0	
Total	1,885	(1,088)	478

Area E: Bakweri Upper Villages & Tole

Base-case - economic values - net present values per hectare at 10% discount rate		
	Forest Maintained £/ha	Conversion to chop farms £/ha
Direct use value - timber or chop farms	28	1,346
Direct use value - NTFPs	37	23
Direct use value - Prunus africana	2,855	0
Carbon storage value	1,391	410
Undiscovered plant-based drugs	2	0
Flood prevention	0	0
Preventing sedimentation	65	0
Non-use value (option, bequest, existence)	62	0
Total	4,440	1,779

1. Introduction

This report presents the findings of a DFID-funded study into the costs and benefits of alternative land use options in forested lowland of the Mount Cameroon Region. The question of which land use brings the greatest net financial and economic benefits is particularly relevant at this time. The Cameroon Development Corporation (CamDev) currently utilises only part of the land it holds under the 1960 "Head Lease". As privatisation approaches attention has to be given to alternative uses of this lease hold land. Here we consider the financial and broader economic returns to oil palm and rubber plantations, sustainable forest use and subsistence oriented agriculture (chop-farms) in each of the five areas identified in the recent draft environmental impact assessment - ERM (1997).

In addition to the costs and benefits of the direct use of the land (from crop or timber production) a broader set of economic values to do with environmental functions of land use also need to be considered. Section 2 therefore begins with a brief overview of the components of total economic value used in this analysis.

The data used, assumptions made and results obtained for each component of total economic value are given in Section 3. Total economic value does not tell us how particular stakeholders will see various land use options. Part of the answer to this lies in looking at "who gets what" from the total net returns to each land use. This is the subject of Section 4.

Section 5 sets out those areas which we believe are priorities for further economic data collection and analysis.

2. Total Economic Value and Land Use Options

Table 2.1 below summarises the components of total economic value (TEV) calculated for land as Chop farms, oil palm and rubber plantations and forest.[1] In the base-case, future costs and benefits were projected over 32 years and discounted at 10% per annum.

Table 2.1 - Components of Total Economic Value

Direct use values	• sale values of crop production, plantation agriculture and sustainable timber use less costs of production; • sale values of non-timber forest products (NTFPs) such as edible and medicinal plants, wooden implements, fish and bush meat less the costs of collection and, where relevant, transport to market; and • export values of Prunus africana bark less collection costs.
Indirect use values	• tonnes of carbon stored per hectare valued at internationally accepted rates; • undiscovered plant-based drugs. The probability of discovery in tropical forest with average biodiversity is combined with a value of new drugs based on past experience less costs of screening to produce an expected value per hectare. • flood protection offered by forest to agricultural land is lost when forest is converted to other land uses. The lost benefit is measured by the occasional loss of agricultural production; and • sedimentation of ground water occurs as forest cover is lost. Finding an alternative water supply imposes direct financial or additional time costs on local communities;
Option & non-use values	• an option value is the payment a potential user of the forest is willing to make to retain the option for using it in future. • individuals have been found to place a value on the existence of (or chance to bequest) endangered species and prized habitats even when they do not expect to visit the areas concerned.

The method used to estimate each of the components of TEV in Table 2.1 is discussed in Section 3.1 onwards. It is worth noting at the outset that we have not been able to

1 For a fuller discussion of the theory see Pearce and Turner (1990) chapter 9.

capture all of the potential indirect use values of the forest. Specifically, we have omitted:

Tourism - which is currently extremely limited in the area. It would be unrealistic to assume that a significant tourist market will develop while the transport infrastructure in the region remains so poor.

Watershed and fish-breeding ground protection - the loss of mangrove forest, in particular, can have a significant impact on fish breeding grounds. As fish are regularly eaten in this part of Cameroon, any large impact on fish stocks and hence prices is likely to be important. This type of issue has been examined in a number of studies of coastal wetlands in the USA[2]. A number of sources of information would be needed to carry out this type of study in the MCP area:

1. scientific data on the relationship between forest loss and fish stocks;
2. estimates of the price elasticity of supply for fish (how much prices would rise if supply falls);
3. an indication of per capita fish consumption and price elasticity of demand (how much less gets consumed if the price goes up).

With this data it is fairly straightforward to estimate the welfare loss (in consumer and producer surplus) implied by loss of forest cover. As we currently have no information on any of these areas we can only note that we have failed to capture the component of indirect use value associated with coastal forest.

The broader economic value of Prunus africana - is not captured in the net financial return from sustainable harvesting of the bark. The economic value will depend on factors which include: the efficacy of the P.africana-derived drugs in maintaining patient quality of life and life expectancy relative to substitute drugs; the value attached to each Quality-adjusted life year (Qualy) in the countries concerned; and the costs of drug manufacture. It is beyond the scope of this study to address these issues and we limit ourselves to the, non-trivial, task of estimating net financial returns of P. africana by area.

Loss of cultural heritage - may be accelerated by the conversion of forest to other uses. Yet there are many forces at work which are producing significant changes in "indigenous" culture and it would be misleading to attribute a given proportion of such change to loss of forest. Attributing a value to such change is also fraught with difficulty and the risk of ethnocentric bias.

2.1 Land-use options considered

The environmental impact assessment carried out by ERM (1997) divides the CamDev operation within Mount Cameroon Project (MCP) area into five sub-areas:

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2 See Lynne et. al. (1981), Ellis and Fisher (1987) and Freeman (1991).

Area A: Mabeta and Bimbia
Area B: West Coast, Debundscha & Etinde
Area C: Idenau, Bomana Corridor & Lower Onge Basin
Area D: Boa Plain, Iloani, Mokoko and Middle Onge Basin
Area E: Bakweri Upper Villages & Tole

In keeping with the CamDev expansion options discussed in ERM (1997) we consider the expansion of oil palm plantations in Areas A (+1000ha), B (+800ha) and C (+800ha). In Area D we consider the large expansion of oil palm (9000ha) and rubber (1000ha) along the lines initially suggested by Wyrley-Birch et. al. (1982).

The obvious alternative to this expansion is sustainable use of the forest and this option is considered as an alternative in each area. However, given the rapid growth of small-scale "chop" farming, it makes sense to consider conversion of forest to chop farms in place of plantation expansion as one land-use option.

Farmer surveys confirm the anecdotal evidence of increasing land shortage, particularly in Areas A and B. This constraint to shifting agriculture has resulted in a significant reduction in fallow periods and a growing incidence of permanent cultivation. Yet few, if any, additional measures are taken to maintain soil quality. Current agricultural practices are therefore unsustainable and do not provide an indication of the "true" return to chop farming. However, this can be inferred from a combination of field survey data and published literature on the relationship between fallow length and yield decline data in the region.

Some expansion of Chop farming is implied by plantation expansion (as estate workers grow their own food crops). Hence we take the implied loss of forest into account when calculating indirect use values (such as carbon storage and flood prevention) that are lost when plantations are substituted for forest.

3. Data, modelling assumptions and total economic values

3.1 Direct use value - Chop farms

3.1.1 Data sources

Preliminary research demonstrated that existing data on chop farm costs, crop prices and yields in MCP area was very limited. In response, MCP commissioned a Rapid Agricultural Survey (RAS) in 8 settlements, across the five geographical working areas in the project region from October 1997 to January 1998. This involved questionnaire based surveys, in-depth discussions with individual farmers and focus group work. A note on the methodology used by Ambrose-Oji, Acworth, Abonge, Oji, and Manga (1998) has been prepared by those responsible and can be found in Annex 1.

A limitation of the data is that farm level costs, yields and prices for each crop have been recorded but data on the amount of land allocated to each crop by farm has not been collected. Hence the analysis has to be undertaken at the level of all farm plots in a given geographic area – as if these constituted one huge farm producing a wide range of crops.

The strength of the questionnaire-based rural agricultural survey (RAS) is that 143 observations are available for analysis. In this survey, farmer's responses refer to all of the farm plots available to the household, including any lying fallow. Detailed questions on time and other inputs were not asked in this general survey but only in the individual farmer visits (FV) – which looked at a sub-sample of farms and one plot per farmer.

The FV cost data therefore has to be scaled up to the whole farm level. This is done by using the ratio of total production costs/total revenue in the FV data to infer input costs for the RAS data. As the unit prices for each crop reported in the FV and RAS are very similar, differences in estimated crop revenue per hectare reflect differences in yield/ha. Hence this method makes production costs/ha proportionate to yield/ha. This tends to overstate fixed costs but, as rent (the main fixed cost) is a very small proportion of total cost, this can only have a minor impact.

In each of the five areas (A to E) the average yield per hectare for each crop grown was calculated as the total yield (in local units subsequently converted into kg) for this crop across all farm plots divided by the total hectarage described as farmland. These figures can be found in Annex 2. The per hectare yields appear very low as, for example, only some farmers plant bananas while the tonnes of bananas they produce are divided by the total amount of farm land. At the same time, yields are recorded for the full range of crops grown in the area. This follows from treating the representative farm as the sum of all constituent farm plots – an approach necessitated by the limitations of the survey data.

Planting materials, chemicals and fertilisers are reported for each crop[3]. In contrast, rent and labour costs are only available at the farm plot level from the FV data. Labour costs are reported for clearing, cultivating, weeding, harvesting and miscellaneous activities. Ambrose-Oji et. al. (1998) use an innovative approach to the valuation of labour whereby farmers were asked to value the daily cost of labour for each task. Tasks such as clearing are charged at a high rate while cultivating is a "cheaper" activity. Total labour costs are calculated by multiplying the person days required for each task by the reported rate for the task[4].

This reflects the *perceived* opportunity costs for each task and is an improvement on adjusting financial costs for shadow wages as a measure of economic cost. However, the relatively low value accorded to women's time is likely to understate the value of child care to society i.e. the true economic cost of women's work is higher than the cost perceived by the farmer.

Crop prices reported in the survey are a mixture of farm gate prices where on-farm sales occur and local market prices – for subsistence use and off-farm sales. The latter two categories are the main ones. Unfortunately, transport costs were not collected in the RAS work. Hence it was necessary to calculate average transport costs using information from key informants on methods of transport and typical quantities together with accepted taxi fares and time costs for standard journeys.

Yield, cost and price data for Chop farms in Area A is given in Table A2 in Annex 2.

3.1.2 Modelling assumptions

As illustrated by Brocklesby and Ambrose-Oji (1997), farming systems in the MCP area are not easily categorised into a stylised model for each area. One of the advantages of using survey data on a large number of farm plots is that this diversity can be captured. Nonetheless, some simplifying assumptions have been made:

- Livestock is not included in the analysis. Rew et. al. (1997) notes that livestock is important in social terms for the Bakweri but is principally a source of wealth rather than a source of income. This is confirmed by Ambrose-Oji et. al. (1998);
- No adjustment is therefore made for subsidies or taxes as purchased inputs such as chemical fertilisers are very limited in this farming system. Where hired labour is used, the informal market wage rate is paid and own labour is valued at its opportunity cost. Produce is mainly for own-consumption with any surplus being sold in local markets. Hence financial and economic values are taken to be equal.

The returns to current agricultural (chop farming) practices tell us what individual farmers can expect from this activity for the time being. This may explain why rational small-scale farmers behave as the do. However, growing land shortages mean that current chop farming practices are unsustainable. We therefore need to identify a

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3 Chemicals and fertilisers are typically only used in high value cash crops such as cocoa, coffee and oil palm.

4 The FV survey data is limited to key farm plots from which we extrapolate to all farming areas. This suggests that our cost estimates are based on the major crops rather than the full range grown. This potentially biases the total cost estimate. However, the direction of this potential bias is uncertain.

sustainable small-scale farming alternative that can be compared to other land uses over the 32 year period used in the economic analysis.

Historically, as documented by Ardener et. al. (1960), fallow periods of 10-16 years were common. The results of the recent rural agricultural survey (RAS) suggest that fallow periods have effectively disappeared in Areas A, B and C. In Area D, a growing number of farmers are moving to permanent cultivation while others are reducing the length of fallow periods. Consequently, the median fallow period is now 3 years. Only in Area E (the upper villages) have traditional farming practices been largely maintained with a median fallow length of 9.5 years. Even here, however, there are signs of change: more than 1/3rd of multi-crop plots reported a fallow-length of five years or less.

In order to construct the "sustainable" chop farm scenario for Areas A to D in an environment of land shortage, we assume for three years cultivation followed by nine years fallow. Current yield figures (from the RAS) will underestimate yields in this scenario as they already incorporate losses from poor agricultural practices[5].

Olu Obi (1989) presents evidence of the long-term effects of continuous cultivation in Southwestern Nigeria. The ultisol in this area is probably only directly comparable to the sandy loam soils in Area D[6], but the (cassava, maize, vegetable, yam) crop mix and farming system studied is broadly similar to that found in the MCP area.

Figure 3.1 below illustrates the recorded yield for cassava grown on four non-consecutive years over an eight year period of continuous mixed cropping without the use of fertiliser. Yield figures declined from approximately 7.5 tonnes/ha in year 1, to 6.5 t/ha in year 4 to 2.8 t/ha in year 6 and finally to 0.8 t/ha in year 8. The author notes that "Other crop species such as maize showed similar trends" p.213.

Lal, Ghuman and Shearer (1992) and Lal (1994) also provide evidence of rapidly decreasing root crop yields in continuously cultivated ultisols and alfisols in Southern Nigeria if there are no interventions to maintain soil structure and nutrients.

This explains the common local practice of continuous cultivation for around three years – while returns are satisfactory - before clearing new land. Working on the basis that current chop farm yields in Areas A to D reflect an equal mix of new, year 2 and year 3 cultivation, current average yields are adjusted upwards in the "sustainable" scenario as follows:

Year 1: Existing yield/0.96;
Year 2: Existing yield;
Year 3: Year 1 yield x 0.91

The adjustment factors being taken from Figure 3.1.

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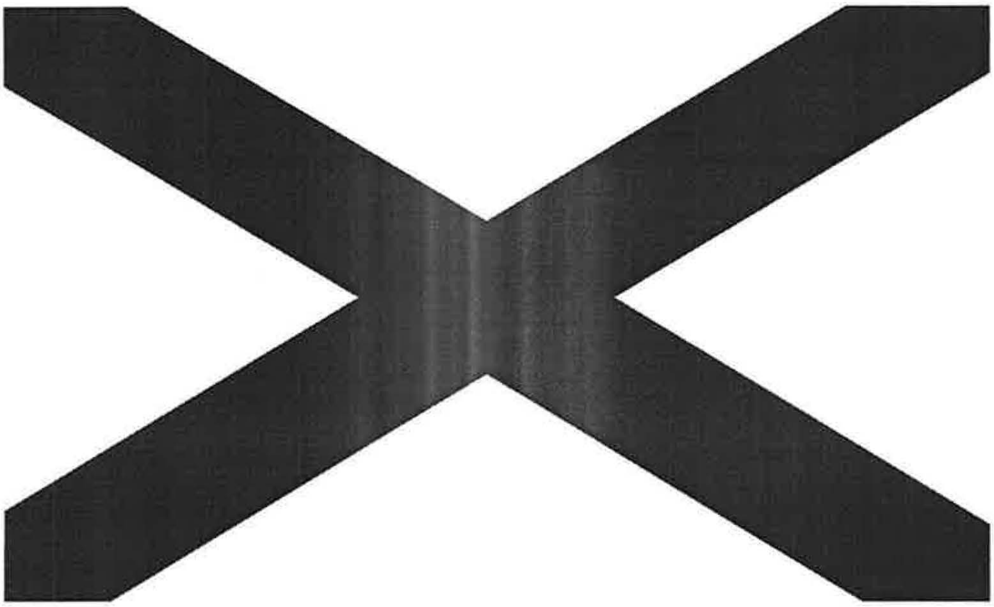
5 It could also be argued that crop prices would rise, as supply would be lower in the sustainable scenario. The price elasticity of supply is, however, unknown.

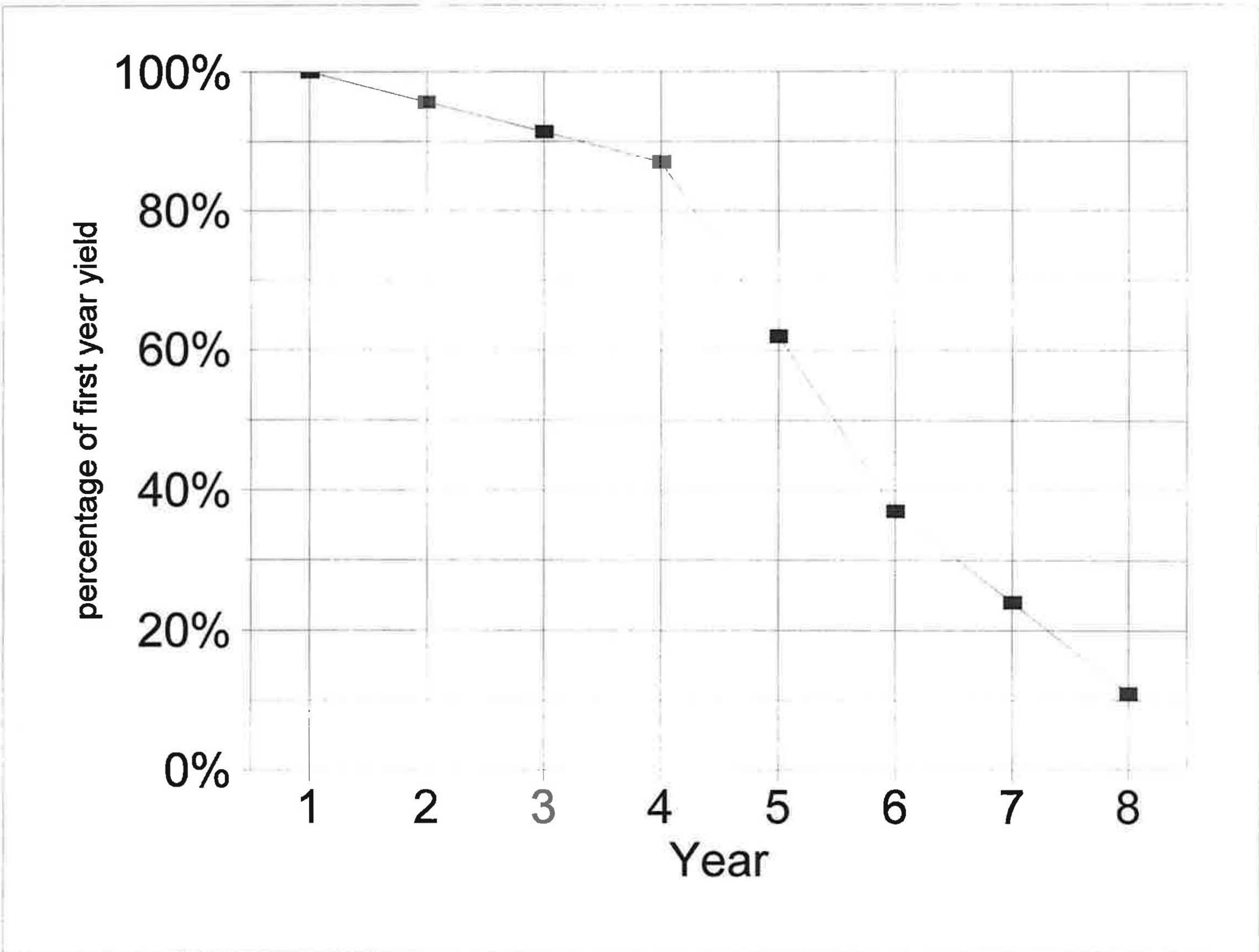
6 According to George Murdoch, personal communication (1998).

Figure 3.1 – The effect of continuous cultivation on cassava



Source: Derived from Olu Obi (1989) p.214

For area E, current yields give a reasonable indication of sustainable yields for the majority of farmers. Nonetheless, a minority have reduced fallow periods significantly. Current average yields across all farmers are therefore likely to be slightly higher than the long-run sustainable yield (using current inputs and technology). Hence, the projected "sustainable scenario" for area E is based on current yields with an annual loss of 1% of the total.



100%
80%
60%
40%
20%
0%
percentage of first year yield
1
2
3
4
5
6
7
8
Year

3.1.3 Results

A detailed breakdown of chop farm costs and revenues for each area can be found in Annex 2.

Table 3.1 below presents the net annual financial return per hectare to chop farming based on *current* practice. This measure is simply the difference between total revenues and total costs for the previous year.

Table 3.1 Annual net returns per hectare chop farming based on current practice

EIA area	Net return (£/ha) – undiscounted
Area A: Mabeta and Bimbia	312
Area B: West Coast, Debundscha & Etinde	283
Area C: Idenau, Bomana Corridor & Lower Onge Basin	157
Area D: Boa Plain, Iloani, Mokoko and Middle Onge Basin	227
Area E: Bakweri Upper Villages & Tole	159

This admittedly crude measure illustrates that farmers in Areas A and B, in which fallow periods have been eliminated, get a higher short-term financial return from their land than those farming sustainably in Area E .
These results are consistent with the limited evidence from the international literature. The per hectare figures in Table 3.1 fall within the US$350-US$600 range that Pearce and Moran (1994) quote as "ball-park" figures for private financial per annum rates of return to farming in the developing world. Perhaps more interesting is the comparison with a detailed financial analysis of forest land use in Bendel, Nigeria.

Osemeobo (1991) estimates the net present value of food crop production over two years as US$881/ha. Using the same methodology, we find the npv of net revenue from chop farming in Area A to be US$894. Osemeobo (1991) also finds a similar level of variation in net revenue across his seven sample sites within the Bendel area as that illustrated in Table 3.1.

Further analysis of the RAS data indicates significant variation in household returns to chop farming across the MCP area. Gross annual average revenues per farming household range from £1424 in Area A to £395 in Area E. This is consistent with the anecdotal evidence on "typical" farm incomes reported by, for example, Rew et. al. (1997).

However, the farm-level picture may be misleading. The large number of dependants per household in Area A produces an annual per-capita revenue from farming of £125, while the equivalent figure in Area E is £57. Chop farming is an important livelihood strategy, but it is usually combined with a wide range of alternatives to minimise risk and, also, to produce a higher standard of living.

Consequently, there are distinct sources of demand for chop farming land. Households with wage earners seek to supplement this income with chop farm produce. CDC workers and those with (at least occasional) paid work in Limbe fall into this category. In more isolated areas, agricultural incomes will constitute a higher proportion of total incomes and changes in product prices and marketing opportunities are likely to have a major impact on the demand for land. Getting a comprehensive understanding of the economic and socio-cultural forces driving land demand is crucial if it is to be influenced by the project.

The annual net returns in Table 3.1 can be projected into the future to give an indication of what farmers may perceive as the net present value of "unrestricted" chop farming. Farmers do report declining yields over time and it is reasonable to assume that they expect this trend to continue in future. Hence our estimate of the long-term expectation of returns to current farming practices is based on reducing the value of total production by 2% per annum (1% for Area E). These figures are given in Table 3.2.

This is inevitably a crude estimate. The main reason for doing this calculation is to consider the rough difference between these figures and those from sustainable farming. This approximate figure indicates the magnitude of the incentives required to induce switching.

Table 3.2 – Farmer's perspective:
Discounted net returns per hectare chop farming based on slow yield decline over 32 years

EIA area	NPV@10%	NPV@35%
	£/ha	£/ha
Area A: Mabeta and Bimbia	2046	790
Area B: West Coast, Debundscha & Etinde	2211	756
Area C: Idenau, Bomana Corridor & Lower Onge Basin	1230	420
Area D: Boa Plain, Iloani, Mokoko and Middle Onge Basin	674	483
Area E: Bakweri Upper Villages & Tole	1346	437

As discussed previously, the economic return to sustainable chop farm agriculture is likely to be somewhat lower than current returns, at least in Areas A to D. Current returns provide an indication of the incentives that the farmer faces but analysis of the economic return to the natural resource must be based on sustainable use. Table 3.3 sets out the estimated net return per hectare for chop farms in each area. The figures given are net present values over a 32 year period (based on a 10% discount rate in the base-case).

Table 3.3 – Society's perspective:
Discounted net returns per hectare chop farming based on traditional fallow lengths over a 32 year cycle

EIA area	NPV@10%	NPV@35%
	£/ha	£/ha
Area A: Mabeta and Bimbia	1110	555
Area B: West Coast, Debundscha & Etinde	1004	499
Area C: Idenau, Bomana Corridor & Lower Onge Basin	558	277
Area D: Boa Plain, Iloani, Mokoko and Middle Onge Basin	813	413
Area E: Bakweri Upper Villages & Tole	565	281

In the base-case, with a 10% discount rate, discounted net returns from farming with traditional fallow periods are generally about half those obtainable using current agricultural practices. With a 35% discount rate (which is probably more appropriate for individual farmers), only the first few years have a large impact. Perhaps surprisingly, this brings the net returns from sustainable farming closer to those from current practice. This is because lost income during a long fallow period is heavily discounted – losing £10 in year 9 is equivalent to losing less than £1 in year 1.

Intriguingly, this suggests that if farmers are to be given a financial incentive to switch to maintaining fallow periods, it would be cheaper to focus on those with the highest discount rates, typically the poorest. This is in contrast to conventional wisdom that suggests high discount rates mitigate against sustainable practices (as these have long term pay-offs).

This is not to say that long-fallow periods are necessarily the most cost-effective form of sustainable agriculture. Ehui, Kang and Spencer (1991), report IITA research from South-western Nigeria which finds that:

- Intensive cultivation of permanent fields using labour-demanding technologies (such as the 4 metre-alley cropping) or external input-demanding no-till system, will only be adopted when shifting cultivation can no-longer be practised. This implies that financial or other incentives would be needed to encourage a switch in farming technology before land shortages reach a critical level; and
- At high discount rates, the no-till system (based on minimum soil disturbance together with use of herbicides) produces higher net returns than the agro-forestry system of alley cropping.

More work is needed to identify which forms of sustainable farming are most appropriate for the MCP area and which groups of farmers are most likely to switch to new technologies. In addition to positive incentives, there may be scope for CDC to apply leverage to farmers on their land (some 20% of all chop farms) to adopt improved farming practices. Restrictions on where inward migrants (principally from Nigeria and NW Cameroon) can start new farms may also be considered. This relates to the stated concern by indigenous groups that they are being overwhelmed by economic migrants with no long term commitment to the area.

3.2 Direct use value - Oil palm and rubber plantations

3.2.1 Data sources

The principal source of data on plantation costs has been CamDev. Detailed operating costs for each area (A..D)[7] have been derived from the CamDev 1997 Performance Report and have been supplemented by information gained from interviews with senior managers. Additional sources of information have been the detailed cost estimates of plantation expansion in the Boa Plain area (D) by Wyrley-Birch et. al. (1982) and an appraisal of CDC oil palm plantations by Fitzgerald (1997).

Our analysis of CDC operating costs is limited by only having access to cost data for one year (1997). Ideally, cost data over a number of years would have been used to eliminate any atypical effects. However, it could be argued that the impending privatisation of Camdev will make current costs a poor good guide to future costs.

Experience of similar privatisations in other African countries suggests that post-privatisation, investment and productivity is likely to rise over time.[8] Yet privatisation will also bring an increase in the cost of capital. Cameroon is regarded as a fairly high risk environment for investment with political instability a concern in the longer-term - EIU (1997). This is reflected in the cost of capital required by shareholders in international private companies investing in Cameroon. Discussions with some of these companies suggest that a discount rate of at least 15% would be applied to any long-term investment.

We allow for the possibility that these changes will affect the viability of new plantations by running sensitivity tests to consider the impact of lower operating costs and a higher discount rate.

The difference between the financial and economic analysis is significant, particularly for palm oil production. Economic valuation modifies the results obtained in the financial analysis by removing all taxes and subsidies and valuing labour at the shadow wage rate. This gives the resource cost to society from undertaking a project.

IMF-guided structural reform since 1989 and a major devaluation in 1994 have resulted in a considerable liberalisation of trade. Import duties on raw materials and capital equipment are now only 10% levied on imports to the Central African Customs Union (UDEAC) - EIU (1997). Moreover, as our main concern is with agricultural and forestry inputs, many of which are produced within the region, the standard conversion factor (SCF) will be close to one.

As for the shadow wage, we follow Wyrley-Birch et. al. (1982) and Ruitenbeek (1989) in taking the shadow wage rate for unskilled labour as 50% of the market rate. The amount of unskilled labour in the total is calculated from CamDev data.

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7 For Area E (Tole) political constraints make the expansion of tea plantations unlikely and we consider maintaining forest versus Chop farm expansion in this area.

8 See Yaron (1997).

The "true" economic value of an internationally-traded commodity such as palm oil is its international border price. This is because the border price (plus transport) is what it would cost in the absence of trade restrictions. In practice, the Government of Cameroon has prohibited imports and has fixed a domestic price some 30% above the current FOB price. This outweighs the move to shadow wages and economic rates of return for oil palm expansion are lower than financial rates of return.

Forecasting future palm oil prices is very difficult but there are a few points worth noting. After a sustained price fall in the 1980s, prices rose in the 1990s to a high in 1994/5. Since then, CIF prices have fluctuated around the US$550/tonne level according to The Public Ledger (1997), 27/10/97 p19. The expected rise in Chinese palm oil imports next season is anticipated to lead to firmer prices but this does not necessarily signify a future trend given the substitutability of soya and palm oil. We therefore take US$550/tonne CIF as the future real price and check to see if the results are sensitive to modest price rises.

As rubber is an export crop, the FOB price (which is given by CDC net of taxes) is used in both the financial and economic analysis. We have used the average price between June and October 1997 as our estimate of future prices, but allow for higher prices in a range of sensitivity tests.

3.2.2 Modelling assumptions

The financial model is based on the following assumptions. Specifically, that:

- The costs of land clearance are incurred in the year clearance occurs but the revenues from timber sales accrue in the following year. This is because key aspects of land clearance for plantation establishment, such as road building, have to be in place before commercial timber can be extracted.
- Basic road upgrading and minimal new road construction is assumed for all new plantation areas in keeping with CDC estimates. In Area D, there are additional costs of heavy drainage and road and bridge building. These costs are derived from Wyrley-Birch *et. al.* (1982), converted into US$ at 1980 prices, adjusted for US$ inflation to yield 1997 prices which are converted back into CFAF.
- Area D expansion is 80% into secondary forest and 20% into high forest. All other areas only involve the clearance of secondary forest.
- Up to three sets of yield figures could be used to model the economics of oil palm expansion: CDC historical data; Wyrley-Birch et. al (1982) estimates (for area D); and the "best practice" yields forecast by Fitzgerald. We have used the latter even though they may be considered optimistic by some observers.
- Following standard practice, 14% of the gross area is set aside for roads, drains, housing and other "non-productive" uses. This is consistent with figures produced for the Boa Plain expansion by Wyrley-Birch et. al. (1982) p.69.
- With the exception of Boa plain/Iloani (D), the increases in production of palm oil are taken to be within the existing processing capacity of the installed plant. The dramatic increase in palm oil production that would result from the expansion of Iloani would necessitate new downstream capacity. Currently, we have no information on marginal storage costs but the capital cost and phasing of new processing capacity is taken as that estimated by Wyrley-Birch et. al. (1982),

converted into US$ at 1980 prices, adjusted for US$ inflation to yield 1997 prices which are converted back into CFAF.

- Oil processing costs given by CDC do not include depreciation and are taken to be mill operating costs only.
- Annualised charges for buildings, vehicles and equipment during the development phase and charges for working capital are derived from Wyrley-Birch et. al. (1982). These costs are subsequently incorporated in CDC operational (general) charges after the development phase. We use the Wyrley-Birch et. al development costs in preference to CDC's amortised plantation development costs/ha as the former are specifically calculated for large-scale plantation expansion (while the CDC figures are based on actual incremental expansion). The difference is actually quite small: The CDC budgeted cost/ha for "upkeep and cultivation" (including amortised plantation development) is CFAF 000 169/ha for Iloani; the comparable figure from our analysis CFAF 000 181/ha.
- We assume all increases in rubber production can be processed using existing plant.
- Development costs for rubber expansion are based on the unit costs estimated for the neighbouring oil palm estates less the cost of drainage.

3.2.3 Results

While there are some differences in the returns to plantation expansion between areas, all share the common feature of being loss making. Given limitations on space we only present detailed results for Mabeta-Bimbia (Area A) in the main report. Full results for each area can be found in Annex 3.

The expansion of oil palm and rubber plantations in any area is not justified in financial or economic terms. Table 3.4 presents the net present value of the net revenue stream of plantation expansion in each area together with the increase in price or decrease in cost required for economic viability.

The only area in which plantation agriculture appears to be within striking distance of economic viability is Idenau (Area C). Yet, even here, international oil palm prices would need to rise 27% to secure a 10% return on capital. Financial viability would be achieved with more modest price rises (or cost reductions) as this is based on the artificially high local palm oil price.

Table 3.4 – discounted net returns to CDC plantation expansion			
	Economic NPV £/ha	% rise in price required for economic viability	% fall in cost required for economic viability
Area A: oil palm	-2882	+140%	-51%
Area B: oil palm	-2352	+100%	-45%
Area C: oil palm	-694	+27%	-19%
Area D: oil palm	-1721	+64%	-36%
Area D: rubber	-3219	+105%	-46%

Notes: Based on a 32 year time period and a 10% discount rate

For economic viability, the international price of palm oil would need to rise by some 64% for the potential 9000 ha expansion in Boa Plain and Iloani to be viable. Alternatively, costs would need to fall by more than a third. Neither of these scenarios appears to be realistic. The fundamental problem for plantation tree crops in the MCP area is the low level of international prices.

Wyrley-Birch et. al. (1982) considered the economics of a 9000ha oil palm and 1000ha rubber plantation in the Boa Plain (Area D). They estimated a financial rate of return for oil palm of nearly 8%. Comparing their figures with our reveals that their estimates of plantation development costs are even higher than those based on CamDev data. The main difference between our data and theirs is the palm oil price.

Wyrley-Birch et. al. (1982) use a forecast of the palm oil (FOB export) price for 1997 of US$578/tonne in constant 1980 prices which translates to approximately US$879/tonne in 1997 prices. Mid-October 1997 CIF Rotterdam prices for palm oil were around US$550/tonne which translates to an FOB price at Douala of approximately US$424/tonne. **Actual palm oil prices are now less than half those projected by Wyrley-Birch et. al. in 1982.** The main reason for the price forecast over-estimate seems to be the failure to anticipate the massive increase in palm oil supply from the Far East.

Table 3.5a - 1000 ha of oil palm expansion in Area A- Mabeta and Bimbia

Year	FFB Yield Tonnes	Average Extraction rate, oil %	Average Extraction rate, kernel %	Planting Programme ha	Land cleared ha	Land clearance & planting cost £	Weeding & upkeep cost £	Harvesting & transport to mill costs £	General charges Estate level £	Processing cost £	General Charges e.g. security £	Packing & despatch £	Group Admin. excluding Contractors £	Total financial cost £
00	0	0.0%	0.0%	0	698	609,837	0	0	0	0	0		0	609,837
0	0	0.0%	0.0%	0	465	54,000	0	0	0	0	0		0	663,837
1	0	0.0%	0.0%	600			150,000	0	0	0	0		0	204,000
2	0	0.0%	0.0%	400			280,000	0	0	0	0		0	280,000
3	0	0.0%	0.0%				192,000	0	0	0	0		0	192,000
4	0	0.0%	0.0%				90,000	0	0	0	0		0	90,000
5	3000	16.0%	2.5%				64,000	69,000	225,000	12,000	4,800	3,36	1,573	379,733
6	5000	17.5%	2.5%				60,000	115,000	375,000	21,875	8,750	6,12	2,868	589,618
7	5000	19.0%	2.5%				51,000	115,000	375,000	23,750	9,500	6,65	3,114	584,014
8	7400	20.0%	3.0%				45,000	170,200	555,000	37,000	14,800	10,36	4,851	837,211
9	9000	21.0%	3.5%				45,000	207,000	675,000	47,250	18,900	13,23	6,194	1,012,574
10	9000	21.0%	3.5%				39,000	207,000	675,000	47,250	18,900	13,23	6,194	1,006,574
11	12600	21.0%	4.0%				35,000	289,800	945,000	66,150	26,460	18,52	8,672	1,389,604
12	15600	21.0%	4.0%				35,000	358,800	1,170,000	81,900	32,760	22,93	10,737	1,712,129
13	16000	21.0%	4.0%				35,000	368,000	1,200,000	84,000	33,600	23,52	11,012	1,755,132
14	16000	21.0%	4.5%				35,000	368,000	1,200,000	84,000	33,600	23,52	11,012	1,755,132
15	16000	21.0%	4.5%				32,000	368,000	1,200,000	84,000	33,600	23,52	11,012	1,752,132
16	16000	21.0%	4.5%				30,000	368,000	1,200,000	84,000	33,600	23,52	11,012	1,750,132
17	14800	21.0%	4.5%				30,000	340,400	1,110,000	77,700	31,080	21,75	10,186	1,621,122
18	13400	21.0%	4.5%				30,000	308,200	1,005,000	70,350	28,140	19,69	9,223	1,470,611
19	11800	21.0%	4.5%				30,000	271,400	885,000	61,950	24,780	17,34	8,122	1,298,598
20	9200	21.0%	4.7%				28,200	211,600	690,000	48,300	19,320	13,52	6,332	1,017,276
21	7400	21.0%	4.7%				27,000	170,200	555,000	38,850	15,540	10,87	5,093	822,561
22	7000	21.0%	4.7%				27,000	161,000	525,000	36,750	14,700	10,29	4,818	779,558
23	7000	21.0%	4.7%				27,000	161,000	525,000	36,750	14,700	10,29	4,818	779,558
24	7000	21.0%	4.7%				27,000	161,000	525,000	36,750	14,700	10,29	4,818	779,558
25	7000	21.0%	4.7%				27,000	161,000	525,000	36,750	14,700	10,29	4,818	779,558
26	6400	21.0%	4.7%				27,000	147,200	480,000	33,600	13,440	9,40	4,405	715,053
27	6000	21.0%	4.7%				27,000	138,000	450,000	31,500	12,600	8,82	4,130	672,050
28	6000	21.0%	4.7%				27,000	138,000	450,000	31,500	12,600	8,82	4,130	672,050
29	6000	21.0%	4.7%				27,000	138,000	450,000	31,500	12,600	8,82	4,130	672,050
30	6000	21.0%	4.7%				27,000	138,000	450,000	31,500	12,600	8,82	4,130	672,050

Table 3.5b - 1000 ha of oil palm expansion in Area A - Mabeta and Bimbia

Year	Financial CDC Oil sales Revenue	Financial CDC Kernel revenue	Economic CDC Oil sales revenue	Economic CDC Kernel revenue	Tea drying fuelwood/ timber value	Financial net profit	Economic net profit
	£	£	£	£	£	£	£
00	0	0	0	0	0	(609,837)	(578,570)
0	0	0	0	0	460,465	(203,372)	(169,336)
1	0	0	0	0	306,977	102,977	113,436
2	0	0	0	0	0	(280,000)	(265,644)
3	0	0	0	0	0	(192,000)	(182,156)
4	0	0	0	0	0	(90,000)	(85,386)
5	156,960	8,400	119,696	8,400	0	(222,773)	(232,168)
6	286,125	14,000	218,196	14,000	0	(303,493)	(327,191)
7	310,650	14,000	236,899	14,000	0	(273,364)	(303,172)
8	483,960	24,864	369,063	24,864	0	(353,251)	(400,359)
9	618,030	35,280	471,303	35,280	0	(394,544)	(454,075)
10	618,030	35,280	471,303	35,280	0	(388,544)	(448,382)
11	865,242	56,448	659,825	56,448	0	(524,362)	(602,084)
12	1,071,252	69,888	816,926	69,888	0	(640,877)	(737,532)
13	1,098,720	71,680	837,873	71,680	0	(656,412)	(755,591)
14	1,098,720	80,640	837,873	80,640	0	(656,412)	(746,631)
15	1,098,720	80,640	837,873	80,640	0	(653,412)	(743,785)
16	1,098,720	80,640	837,873	80,640	0	(651,412)	(741,888)
17	1,016,316	74,592	775,032	74,592	0	(604,806)	(688,381)
18	920,178	67,536	701,718	67,536	0	(550,433)	(625,956)
19	810,306	59,472	617,931	59,472	0	(488,292)	(554,613)
20	631,764	48,429	481,777	48,429	0	(385,512)	(434,913)
21	508,158	38,954	387,516	38,954	0	(314,403)	(353,918)
22	480,690	36,848	366,569	36,848	0	(298,868)	(336,171)
23	480,690	36,848	366,569	36,848	0	(298,868)	(336,171)
24	480,690	36,848	366,569	36,848	0	(298,868)	(336,171)
25	480,690	36,848	366,569	36,848	0	(298,868)	(336,171)
26	439,488	33,690	335,149	33,690	0	(275,565)	(309,552)
27	412,020	31,584	314,202	31,584	0	(260,030)	(291,806)
28	412,020	31,584	314,202	31,584	0	(260,030)	(291,806)
29	412,020	31,584	314,202	31,584	0	(260,030)	(291,806)
30	412,020	31,584	314,202	31,584	0	(260,030)	(291,806)
	Npv @ 10%					(3,154,794)	(3,350,848)
	Npv/hectare @ 10%					(2,713)	(2,882)

3.3 Direct use value - Timber from sustainable forest management

3.3.1 Data sources

Recent forest inventory data for Areas D and C is used to estimate sustainable timber yields. The MCP inventory is based on 13ha sample and 60 species of which 40 are commercially exploited. Full details are given in Acworth et. al. (1996). Volumes in size classes 70-80cm, 80-90cm, 90-100cm and 100cm+ are estimated and maximum sustainable yield volume (from stems above 80cm) calculated for 20 and 25 year cutting cycles. Realistic exploitable yields are taken as half the maximum sustainable yield.

The inventory data for Area E is taken from the ONADEF inventory. This is limited to seven commercially exploited species and is likely to produce an underestimate of timber values.

Timber prices are based on current commercial prices (generally for export). Export prices and detailed cost figures for logging in each area were provided by Acworth (1997) following his interviews with local industry sources.

3.3.2 Modelling assumptions

As the supply of tropical commercial timber species continues to decline, prices will continue to rise in real terms. To some extent this will be offset by the adoption of non-traditional timber species but this is a slow process. Consequently, we have assumed a modest real price increase of 1% per annum.

Economic values are calculated by removing all taxes and applying the shadow wage to labour costs. These are estimated to be in the same proportion to total costs in sustainable forestry as in oil palm production.

Relative to Area C, Area A is taken to have 70% of exploitable trees/ha and 70% of exploited volume of timber/ha. This reduction in estimated timber stocks is partly offset by the lower cost of transport from Area A and, to a lesser extent, Area B to Douala.

3.3.3 Results

Export-based sustainable timber exploitation is profitable but produces a fairly low rate of return per hectare.

As Table 3.6 below shows, sustainable timber exports from Area A produces a net present value of £104/ha in financial terms at a discount rate of 10% or £174/ha at a 6% discount rate. Vincent (1990) using a 6% discount rate estimates the npv of export quality timber from Malaysian forests at US$280/ha[9] (£168/ha). The net

9 The figure quoted is US$230/ha in 1990 prices which translates to approximately US$280/ha at current prices.

timber revenue per hectare for Area B is slightly lower than Area A as transport distances to Douala are greater.[10]

In economic terms the returns are considerably higher, with net present value in Area A of £428/ha at a 10% discount rate. This reflects the relatively high proportion of net forestry revenue which is intended to be taken by taxes.

3.4 Direct use values - Non-timber forest products (NTFPs)

3.4.1 Data sources and assumptions

Base line socio-economic and local market data has been collected for the West Coast and Bomana corridor areas (B and C) and is reported in Ambrose-Oji (1997) and Ambrose-Oji and Pouakouyou (1997). This data contains information on NTFP quantities and sale prices as well as bush meat and wooden implements such as hoe and axe handles. Further analysis of this data by Ambrose-Oji allowed the aggregation of NTFPs collected by individuals and those purchased from local markets on a per hectare basis.

Unless indicated otherwise, all these items will be collectively referred to as NTFPs.

In order to extrapolate to Area D we make use of forest inventory data for both areas to compare the relative density of eight of the most important tree species associated with NTFPs. While these indicate potential (stock) values rather than actual use it seems reasonable to use the difference in stock levels to scale our per hectare estimates from Area C.

In the absence of forest inventory data for Areas A and E which can be compared with Area B or C to estimate NTFP stock differences, we rely on key informant views on the relative productivity of each area. In Area A, plantations are expected to yield the same NTFP values as Area B, forest areas only 70% of this value (due to degradation) and farmland, 80% of the Area B value (due to pressure on fallow land). For Area E, there is no data on NTFP yield from the tea estate, but farmland and forest NTFP production per hectare are assumed equal to that in Area C.

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10 Results differ slightly for Areas D & C as some of the costs involved are fixed costs while the area exploited is 1000 ha for C and 10,000 ha for D.

Table 3.6 - Sustainable Timber Production - Area A - Mabeta & Bimbia

Year	Annual yield m3	Inventory & camp construction costs FCFA 000	Road building, production & Transport costs FCFA 000	Official Taxes Local & export FCFA 000	Gross Revenue FCFA 000	Financial Revenue FCFA 000	Economic Net Revenue FCFA 000
0	0	3,800	3,125	20	0	(6,945)	(6,570)
1	439		11,300	13,621	34,470	9,550	23,750
2	439		11,300	13,621	34,815	9,894	24,094
3	439		11,300	13,621	35,163	10,242	24,442
4	439		11,300	13,621	35,514	10,594	24,794
5	439		11,300	13,621	35,870	10,949	25,149
6	439		11,300	13,621	36,228	11,308	25,508
7	439		11,300	13,621	36,590	11,670	25,870
8	439		11,300	13,621	36,956	12,036	26,236
9	439		11,300	13,621	37,326	12,406	26,606
10	439		11,300	13,621	37,699	12,779	26,979
11	439		11,300	13,621	38,076	13,156	27,356
12	439		11,300	13,621	38,457	13,537	27,737
13	439		11,300	13,621	38,842	13,921	28,121
14	439		11,300	13,621	39,230	14,310	28,510
15	439		11,300	13,621	39,622	14,702	28,902
16	439		11,300	13,621	40,018	15,098	29,298
17	439		11,300	13,621	40,419	15,498	29,698
18	439		11,300	13,621	40,823	15,903	30,103
19	439		11,300	13,621	41,231	16,311	30,511
20	439	3600	8,175	13,621	41,643	16,248	30,472
21	439		8,175	13,621	42,060	20,265	34,304
22	439		8,175	13,621	42,480	20,685	34,725
23	439		8,175	13,621	42,905	21,110	35,150
24	439		8,175	13,621	43,334	21,539	35,579
25	439		8,175	13,621	43,768	21,972	36,012
26	439		8,175	13,621	44,205	22,410	36,450
27	439		8,175	13,621	44,647	22,852	36,892
28	439		8,175	13,621	45,094	23,299	37,338
29	439		8,175	13,621	45,545	23,749	37,789
30	439		8,175	13,621	46,000	24,205	38,245
		NPV Per ha (at 10%)				104	226

NTFP and bushmeat values per hectare have been assumed to remain constant over time. This will only hold true if current yields (on which our figures are based) are sustainable. For NTFPs in any particular land use (farming, secondary forest etc.) this may be a reasonable assumption, but there is considerable anecdotal evidence that bushmeat from forest areas is becoming more difficult to find. Consequently, by assuming a constant value of bushmeat per hectare we are implicitly assuming the price will rise in proportion to the reduction in supply.

Deriving cost estimates for plant-based NTFP collection is requires a view to be taken on the amount of time spent on this activity. Labour time specifically allocated to NTFP collection is minimal for most products, with the exception of snail collection (in plantations) and bushmeat hunting. Collection of plant-based NTFPs on fallow land occurs during the farming day and it is common for plants and tree fruits to be gathered "on route" to somewhere else (Ambrose-Oji pers. Comm.).

Peters, Gentry and Mendlesohn (1989) in their valuation of (timber and non-timber) forest products estimate harvesting costs of 40% of the product value based on logging and transport costs in the formal sector. The Hot Springs Working Group (1995) also estimate a 40% of gross value figure for woodland fruit collection in Zimbabwe. However, this is likely to be far greater than actual NTFP collection costs in the MCP area for the reasons given above. A more reasonable estimate of labour costs as a share of total plant-based NTFP value *for the MCP area* is 10%.

Bushmeat hunting is undertaken largely by professional hunters and labour costs are therefore a significant share of total product value. The equipment used is typically home made and depreciation costs are small but an allowance has to be made for consumable items such as gun cartridges. While these costs have not been systematically recorded, discussions with key informants suggest that hunting costs may account for 40% of the market value of bushmeat. Transport and marketing costs (estimated as 20% of the total value) also have to be deducted from sales revenues from local market towns.

Finally, as NTFP and bush meat sales are not formally taxed and the labour used is principally "own-labour", financial and economic values will be equal.

3.4.2 Results

Table 3.7 below gives NTFP costs and revenues for Area A. Net revenues for the broad category of NTFP from the forest in the other Areas (B..E) are approximately 50% higher in per hectare terms i.e. £37/ha.

Perhaps the most surprising result is the relatively high value of plantations as a source of NTFPs. This reflects the collection of snails and, in many cases, their sale in local markets. It is possible that limited access to these markets in more remote parts of Area D will lower the return to plantations.

The results for Areas B to E are consistent with the "guestimates" for sustained forest use produced for Korup national Park by Ruitenbeek (1989). Barbier et. al. (1993)

also produce similar estimates of agricultural, fishing and fuelwood benefits from the Hadjia-Nguru floodplain in Northern Nigeria.

Some figures for NTFP values in tropical forest reported in the literature are much higher. Pearce and Moran (1994) report net present value estimates from unpublished research in the order of US$3000/ha but these would seem to rely on a much more intensive use of the forest - perhaps due to the absence of other income earning opportunities - than we observe in the MCP area.

Table 3.7a - NTFP - Mabeta and Bimbia base data

	Area A (based on Area C x adjustment factors)						
Household data	Raw value in 9 or 10 Month survey CFAF	Adjust for collection cost CFAF	Adjust for transport and marketing cost CFAF	Net annual value in survey sample CFAF	Net annual value for population in area CFAF	Net annual value per Ha CFAF	Ratio of NTFP in Area A:C
Household data							
Plantation	87,500	56,850	0	75,800	1,478,100	584	1
Farmland	66,850	49,860	0	66,480	1,296,360	1,620	0.8
Secondary forest	155,005	112,865	0	150,486	2,934,477	3,668	0.7
Blackbush	150,750	100,980	0	134,640	2,625,480	656	0.7
Market data							
Plantation	13,200	11,520	8,880	10,656	17,760	7	1
Farmland	789,395	475,617	317,738	381,286	635,476	794	0.8
Secondary forest	262,758	159,755	107,203	128,644	214,406	268	0.7
Blackbush	1,490,945	936,057	637,868	765,442	1,275,736	319	0.7
TOTAL							
Plantation						591	1
Farmland						2,415	0.8
Secondary forest						3,936	0.7
Blackbush						975	0.7

Table 3.7b - NTFP – Mabeta and Bimbia net revenues

Sustainable NTFP values - only secondary forest in this area			
	Chop farm	Plantation	Secondary forest
Year	CFAF 000/ha	CFAF 000/ha	CFAF 000/ha
00	1.9	0.6	2.8
0	1.9	0.6	2.8
1	1.9	0.6	2.8
2	1.9	0.6	2.8
3	1.9	0.6	2.8
4	1.9	0.6	2.8
5	1.9	0.6	2.8
6	1.9	0.6	2.8
7	1.9	0.6	2.8
8	1.9	0.6	2.8
9	1.9	0.6	2.8
10	1.9	0.6	2.8
11	1.9	0.6	2.8
12	1.9	0.6	2.8
13	1.9	0.6	2.8
14	1.9	0.6	2.8
15	1.9	0.6	2.8
16	1.9	0.6	2.8
17	1.9	0.6	2.8
18	1.9	0.6	2.8
19	1.9	0.6	2.8
20	1.9	0.6	2.8
21	1.9	0.6	2.8
22	1.9	0.6	2.8
23	1.9	0.6	2.8
24	1.9	0.6	2.8
25	1.9	0.6	2.8
26	1.9	0.6	2.8
27	1.9	0.6	2.8
28	1.9	0.6	2.8
29	1.9	0.6	2.8
30	1.9	0.6	2.8
NPV/ha @ 10% discount rate	18.4	5.6	26.2

3.5 Direct use value - Prunus africana

3.5.1 Data sources and assumptions

Our intention to undertake a detailed economic analysis of Prunus africana in the MCP area has been frustrated by the unwillingness of Plantecam to provide any data. Hence we simply attempt to give an order of magnitude of the net returns to sustainable utilisation in the areas concerned. Further work is required to identify the costs and revenues associated with Prunus africana-based herbal preparations. The aim should be to estimate the level of payment for local supplies of bark that is consistent with an adequate return on the capital necessary for production of the bark extract.

Data is drawn from Acworth, Njombe Ewusi, and Donalt (1997) and the recent ONADEF Prunus inventory. Using the Acworth et. al. (1997) estimate of 64kg/tree/5 year period as a sustainable yield implies a total annual yield of 144 tonnes in EIA area E and 50 in EIA area C[11]. If Plantecam's historical yield of 100kg/tree is used the annual yield would be 243 tonnes/annum and 84 tonnes/annum in areas E and C respectively.

As noted in Section 2, financial rather than true economic values are used to value this yield. Bark is purchased at the Plantecam factory at prices ranging from CFAF 104/kg (US$0.16/kg) for bark with a high moisture content to CFAF 270/kg (US$0.45/kg) for dry bark. We take an average of CFAF 170/kg as the sale price for legally harvested bark realised by local collectors. What we do not know is the cost of collection, the costs of basic processing or final export price of the bark extract.

Cunningham, Cunningham and Schippmann (1997) quote a 1992 export price for unprocessed Kenyan bark of US$2/kg and recent figures for Tanzanian bark exports of US$2-$10/kg. As the principal costs associated with unprocessed bark are collection and drying, the difference between FOB sale price and dry bark purchase price is a reasonable guide to the profitability of bark exports. As an indicative figure therefore, the net return (profit) per kilo of exported bark (rather than bark extract) could be around US$5/kg or CFAF 3000/kg. This tentative figure is the basis of an **economic** value of Prunus africana.

A final assumptions is that where land is cleared to establish new plantations it is reasonable to assume all P. africana trees would be cut or burnt along with other vegetation. At 900m plus, such plantations would be eucalyptus rather than tree crops. This is less likely where forest land is converted to Chop farms as the bark of P. africana is valued for its medicinal properties in addition to being a potential source of income. Nonetheless, to investigate the scale of the maximum potential loss we assume that conversion to agricultural use implies all prunus trees are cleared.

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11 Derived from Table 1 of Acworth et. al. (1997)

3.5.2 Results

Net P. africana revenues for Areas C and E can be found in Table 3.8 below. These figures suggest that in the West Coast area (area C), the per hectare **financial** value of conserving P. africana in the forest may be of a similar magnitude to the per hectare value of all other NTFPs (plant and bushmeat) combined. In the Upper Villages (area E), P. africana is the most valuable forest product, with a per hectare financial value greater than that estimated for combined sustainable timber and NTFP use.

As noted above, the **economic** values calculated for P. africana are necessarily tentative given the limited data available. However, it is clear these are significantly greater than the net financial returns. Table 3.6 suggests that discounted net economic returns may be as high as £2,900 per hectare for the Upper villages (area E) using the lower of the two methods for calculating bark yield. The equivalent figure for Area C is £700/ha.

The sustained use of forest land containing P. africana is far more valuable to the world in general than conversion to agriculture or plantations. This is not perceived at the village level as there is a huge gap between the economic returns (based on the international export value of the bark extract) and the financial returns earned by those who collect the bark. Hence where there is direct competition for land, the financial returns to local people from P. africana are lower than the financial returns to chop farming.

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Despite this, P. africana is a very important income source for young men (who do the bark harvesting) in a number of villages. There are few alternative sources of cash income which encourage this group to stay in the villages rather than migrating to towns. For this reason, encouraging and assisting farmers to grow P. africana as an agro-forestry crop on chop farm land is a serious conservation strategy. Nkefor, Ndam, Blackmore and Ebile (1997) review the experience to date of "conservation through cultivation" in the MCP area. They identify three critical issues:

- Security of the international markets;
- Farmers ownership of the planted P. africana once they become mature; and
- Scientific concern to ensure that only good provanences/cultivars/varieties are multiplied and distributed for cultivation.

The first issue is vital as returns to P. africana can only start to be realised some 15 years after planting. Despite the high discount rates that local farmers use, the high potential net returns of the bark make it an attractive tree to plant. The problem is the *uncertainty* associated with the market i.e. will there be a demand for P. africana bark in 15 years time?

The evidence presented by Cunningham, Cunningham and Schippmann (1997) suggests a growing demand for herbal preparations based on P. africana bark extracts and synthesis of the active ingredients does not appear to be viable[12]. Yet there will

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12 According to Paul Blackmore, personal communication.

inevitably be uncertainty associated with future demand for this product and a key question is "who is best placed to bear the risk?".

Low income farmers who are being encouraged to plant P. africana are far less able to bear this risk than pharmaceutical companies with a diverse portfolio, the Government of Cameroon or the international donor community. In theory, less risk averse institutions should be able to take on some of this risk in return for a share of the profit if the market develops. While this may sound far removed from the reality of Bakweri upper villages, the following is worth considering.

Plantecam (or another pharmaceutical company) could guarantee a minimum purchase price and quantity for P. africana bark in 15 years time. This minimum need only cover the costs of planting materials and labour if the trees are part of an agro-forestry regime. The agreement itself has to be credible which suggests it has to be "high profile" (structured and monitored by an international NGO, for example) with promise-to-purchase certificates based on a proportion of trees planted.

Table 3.8 Financial returns to sustainable harvesting of Prunus africana

	Area E				Area C			
Year	Total Harvest 64kg/tree Tonnes	Total harvest 100kg/tree Tonnes	Net Revenue 64kg/tree £	net Revenue 100kg/tree £	Total harvest 64kg/tree Tonnes	Total harvest 100kg/tree Tonnes	Net Revenue 64kg/tree £	Net Revenue 100kg/tree £
0	144	243	244,800	412,597	50	84	85,000	143,263
1	144	243	244,800	412,597	50	84	85,000	143,263
2	144	243	244,800	412,597	50	84	85,000	143,263
3	144	243	244,800	412,597	50	84	85,000	143,263
4	144	243	244,800	412,597	50	84	85,000	143,263
5	144	243	244,800	412,597	50	84	85,000	143,263
6	144	243	244,800	412,597	50	84	85,000	143,263
7	144	243	244,800	412,597	50	84	85,000	143,263
8	144	243	244,800	412,597	50	84	85,000	143,263
9	144	243	244,800	412,597	50	84	85,000	143,263
10	144	243	244,800	412,597	50	84	85,000	143,263
11	144	243	244,800	412,597	50	84	85,000	143,263
12	144	243	244,800	412,597	50	84	85,000	143,263
13	144	243	244,800	412,597	50	84	85,000	143,263
14	144	243	244,800	412,597	50	84	85,000	143,263
15	144	243	244,800	412,597	50	84	85,000	143,263
16	144	243	244,800	412,597	50	84	85,000	143,263
17	144	243	244,800	412,597	50	84	85,000	143,263
18	144	243	244,800	412,597	50	84	85,000	143,263
19	144	243	244,800	412,597	50	84	85,000	143,263
20	144	243	244,800	412,597	50	84	85,000	143,263
21	144	243	244,800	412,597	50	84	85,000	143,263
22	144	243	244,800	412,597	50	84	85,000	143,263
23	144	243	244,800	412,597	50	84	85,000	143,263
24	144	243	244,800	412,597	50	84	85,000	143,263
25	144	243	244,800	412,597	50	84	85,000	143,263
26	144	243	244,800	412,597	50	84	85,000	143,263
27	144	243	244,800	412,597	50	84	85,000	143,263
28	144	243	244,800	412,597	50	84	85,000	143,263
29	144	243	244,800	412,597	50	84	85,000	143,263
30	144	243	244,800	412,597	50	84	85,000	143,263
Npv (@ 10% discount rate)			2,320,462	3,911,014			805,716	1,357,991
Hectares			14,265	14,265			20,091	20,091
Npv/ha			**163**	**274**			**40**	**68**

Table 3.9 Economic returns to sustainable harvesting of Prunus africana

	Economic Basis			
	Area E		**Area C**	
Official Price paid £	Total harvest 64kg/tree Tonnes	net revenue 64kg/tree £	Total Harvest 64kg/tree Tonnes	net revenue 64kg/tree £
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
3000	144	4,320,000	50	1,500,000
NPV @ 10%		40,949,337		14,218,520
Hectares		14265		20091
NPV/ha		**2,871**		**708**

3.6 Indirect use values - Carbon Storage

3.6.1 Data sources and assumptions

In principal, the MCP forest inventory data could be used as the basis for accurate carbon storage figures for the specific mix, size and density of trees in the forest. However, this is a significant project in itself and, for the purpose of this report, we use general carbon sequestration figures for tropical forest types versus shifting agriculture produced by Brown and Pearce (1994). Taking (oil palm and rubber) plantation biomass as equivalent to tropical open forest we have the following:

Land-use	tC/ha
Closed primary forest	283
Closed secondary forest	194
Open forest ≈ plantation	115
Shifting agriculture ≈ sustainable chop farming	79
Permanent agriculture ≈ current chop farming	63

As for the value to placed on CO2 emissions, Pearce and Moran (1994) quoting work by Frankhauser, give a central damage figure of US$20/tonne (in 1994 prices). However, a number of USIJI-approved projects for carbon sequestration in Costa Rica are based on carbon credits of approximately US$10/tonne. Suggested values for an EU carbon tax are also lower - in the range of £4-5/tonne - which is consistent with the Forestry Commission figure of £4.26/m3 (in 1996 prices).

Given the increasing evidence of global warming and rising public awareness of the issue, there is a chance that the real value of offsetting carbon emissions will rise over time. With this and the discussion above in mind, we consider three scenarios:

a) low indirect value - £3/tonne carbon rising to £5/tonne over a 32 year period;
b) base-case - £6/tonne carbon rising to £12/tonne over a 32 year period; and
c) high indirect value - £15/tonne rising to £25/tonne over a 32 year period.

Assumptions are also needed on the rate of accumulation of biomass in plantations. Biomass is taken to rise linearly to the point at which maturity is reached and to remain constant thereafter. We assume that trees cleared for plantations or agriculture are burned and return their stored carbon to the atmosphere (rather than being converted to furniture which would delay the release of CO2).

3.6.2 Results

The base-case (scenario b) results for Area A summarised in Table 3.10 below, show that the discounted value of carbon storage in the 1163 ha of forest in question is worth approximately £1.9 million over a 32 year period. If the land is converted to (sustainable) chop farm agriculture some £613,00 of carbon is stored. The equivalent figure for conversion to plantations (with some induced agriculture at the periphery) is almost £490,000. In per hectare terms, carbon fixing by the forest is worth some £1,400/ha with chop farming and plantations valued at £527/ha and £487/ha respectively[13].

Carbon storage values are therefore by far the largest source of total economic value of the forest.

Similar per hectare figures are estimated for agricultural and plantation expansion into forest in areas B, C and E. The expansion of plantations in Area D implies a loss of some high forest with a higher cost in terms of lost carbon storage.

All of the above are based on fairly conservative carbon fixing values. If, instead, we use figures similar to those suggested by Frankhauser (scenario C above), the discounted values will more than double. In this case, the value of carbon storage provided by the forest is far greater than any other use of the forest land.

Even the base-case value of carbon storage constitute by far the largest component of forest values, being something like six times the full economic net present value of sustainable timber production. Yet the value of carbon storage will not be captured as a financial benefit by the Government of Cameroon unless forest in the MCP area forms part of a carbon offset agreement for a foreign company or a debt-for-nature swap. To date, most arrangements of this type have occurred in the US or Latin America although Nigeria, Zambia and Madagascar have benefited from debt-for-nature swaps.[14]

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13 The relatively low figure for plantations reflects the time taken for palm trees to grow to maturity, which leads to future carbon storage being discounted.

14 See Pearce and Moran (1994).

Table 3.10 - Carbon storage implications of conversion of 1163 ha of forest to oil palm or chop farm use – Area A

Value of carbon fixed in:

	secondary forest	Oil palm plantations	Chop farms (sustainable)
Year	£	£	£
00	1,586,288	0	0
0	52,876	0	569,535
1	52,876	36,800	18,372
2	52,876	89,700	18,372
3	52,876	69,000	18,372
4	52,876	72,833	18,372
5	52,876	76,667	18,372
6	52,876	80,500	18,372
7	52,876	84,333	18,372
8	52,876	88,167	18,372
9	52,876	92,000	18,372
10	52,876	95,833	18,372
11	52,876	99,667	18,372
12	52,876	103,500	18,372
13	52,876	23,000	18,372
14	52,876	23,000	18,372
15	52,876	23,000	18,372
16	52,876	23,000	18,372
17	52,876	23,000	18,372
18	52,876	23,000	18,372
19	52,876	23,000	18,372
20	52,876	23,000	18,372
21	52,876	23,000	18,372
22	52,876	23,000	18,372
23	52,876	23,000	18,372
24	52,876	23,000	18,372
25	52,876	23,000	18,372
26	52,876	23,000	18,372
27	52,876	23,000	18,372
28	52,876	23,000	18,372
29	52,876	23,000	18,372
30	0	0	0
Npv	1,895,226	487,013	612,954
Npv/ha	1,391	487	527

10% discount rate used

3.7 Indirect use value - loss of undiscovered plant-based drugs

3.7.1 Data sources and assumptions

Ruitenbeek (1989) was one of the first to use the valuation methodology of patent rights to estimate the potential value of undiscovered plant-based drugs for the pharmaceutical industry. His estimated value for the Korup park and surrounding management area is £0.1/ha per annum. Pearce and Moran (1994) estimate a range of values for tropical forest, which are generally larger than that produced by Ruitenbeek i.e. ranging from US$0.1/ha to US$21/ha. The most recent work on this issue, by Mendlesohn and Balik (1997), gives a value for undiscovered plant-based drugs in tropical forest with average plant endemism of US$3/ha.

The number of endemic plant species per hectare is very important as a predictor of potential drugs according to Mendlesohn and Balik (1997). If an area of tropical forest had ten times more endemic species per hectare than average, their model predicts a per hectare future drug value of US$30/hectare.

3.7.2 Results

We base our estimates on the core estimates of Mendlesohn and Balik (1997). Species endemism in Area A is taken to be 70% of the average which gives a net present value to society as a whole of approximately £1.4/ha (US$2.1/ha) or £0.04/ha per annum. Estimates for Areas B, C, D and E are based on average rates of endemic plant species implying a net present value of £2/ha.

Despite the high profile given to this issue, it is a very small component of forest economic value. Moreover, the figures quoted are economic values associated with the forest rather than financial returns available to those in Cameroon (and still less to those in the forest area). It is generally assumed that no more than 10% of this economic rent finds its way back to the country with the forest in the form of royalties and drug licensing fees[15].

3.8 Indirect use values - Flood prevention

3.8.1 Data sources and assumptions

There is good scientific evidence which indicates that loss of forest cover is likely to result in an increased incidence of flooding. Indeed, considerable anecdotal evidence exists to suggest that flooding in many parts of the MCP area has become more common as forest land is cleared.

The areas most at risk of flooding are Area D (Boa Plain, Iloani, Mokoko and Middle Onge Basin) and some parts of Areas B (West Coast, Debundscha & Etinde) and Area C (Idenau, Bomana Corridor & Lower Onge Basin).

15 Ruitenbeek (1989) and Pearce and Moran (1994).

Barbier, Adams and Kimmage (1993) estimate the value of forest flood protection as the loss of farm production in The Hadejia-Nguru Wetlands of Nigeria. Ruitenbeek (1989) follows the same principle, albeit with very little data, for the Korup national park in Cameroon.

The implied loss of agricultural production from increased flooding in any of the MCP areas is not known with any degree of accuracy. It can only be estimated in broad terms using "reasonable" parameters. Following the literature we have taken these parameters to be the following for conversion to agriculture:

	Scenario		
	A	B	C
Proportion of farmers affected by floods	25%	50%	75%
Loss of crop as a % of total crop	25%	50%	75%
Proportion of years affected by floods	20%	33%	50%
(implies flood every)	5 years	3 years	2 years

Where Scenario B is the base-case.

The amount of agricultural land in each area that is vulnerable to flooding **as a result of the conversion of forest in question** is taken to be only that land from which forest cover is lost. This is a very cautious assumption and, if additional land were to be affected, the estimated forest protection value would rise accordingly.

Plantations are also vulnerable to inundation but it can be argued that the major impact would be felt in agricultural land rather than plantations constructed around drainage channels. Given the degree of uncertainty in these estimates we confine ourselves to projecting the impact of increased flood incidence on agriculture.

3.8.2 Results

This lost value can be treated as a cost of conversion to plantation or agriculture and subtracted from the net present value of these activities. The alternative, which we adopt, is to treat the prevention of lost production as a benefit which accrues to the sustainable use of the forest. The results for all areas are given in Table 3.11.

Flood protection is clearly an important potential benefit that can accrue to the preservation of forest. More work is needed to identify the relationship between deforestation and the increased incidence of flooding in the MCP area.

Table 3.11 - Flood prevention values for forest land: Net present values at 10% discount rate

EIA area	NPV £/ha
Area A: Mabeta and Bimbia	0
Area B: West Coast, Debundscha & Etinde	126
Area C: Idenau, Bomana Corridor & Lower Onge Basin	143
Area D: Boa Plain, Iloani, Mokoko and Middle Onge Basin	168
Area E: Bakweri Upper Villages & Tole	0

3.9 Indirect use value - Preventing the sedimentation of water courses

3.9.1 Data sources and assumptions

Sedimentation of water courses following deforestation was mentioned a number of times by MCP field staff as an issue for concern. At least one village is reported to have switched from river water to ground water supply as a result of increased sedimentation. In many cases, women have to travel further to collect acceptable drinking water and also to find water which is suitable for washing clothes. The value of preventing sedimentation is therefore partially captured by the additional time spent on these tasks evaluated at the shadow wage rate.

Increased sedimentation will also have an impact on river fish. Translating this into economic terms is particularly difficult as the likely rates of sedimentation will favour some species at the expense of others[16].

Estimates of the value of preventing sedimentation are therefore based on the cost of some proportion of villages switching to groundwater supplies (or additional time-costs in water collection) and the additional time-costs in finding clean water for clothes washing.

Yaron, Forbes Irving and Jansson (1994) estimate the costs of rural water supply in Africa based on a range of technologies. A conservative cost estimate is £4 per household per annum based on household consumption of 200 litres/day, a 10 metre pumping head and a single supply point for a village of 200 households.

As noted previously, we follow Ruitenbeek (1989) and Wyrley-Birch et. al. (1982) and take the shadow wage to be 50% of the unskilled daily labour rate. This translates to a shadow daily rate of approximately £0.65/day.

Translating this into time-costs for water collection requires an estimate of the additional time necessitated by a journey to an alternative water source. If this is ¼ of an hour per day on average, the implied time-cost per affected household ranges from £2.28/annum in Area C to £6.84/annum in Area A.

If the additional time taken to find a suitable water source for clothes washing is ½ an hour per week, the implied time cost per household ranges from less than £1/annum in Area C to approximately £2/annum in Area A.

16 G. Davies pers. communication.

Total household population estimates are based on EIA (1997) for residents and the socio-economic survey reported by Rew et. al. (1997) for family size by area. These are:

Area	Population in Area	Average household size – derived from	Households in Area
	(EIA, 1997)	Rew et.al. (1997)	
A	7000	5.95	1176
B	4000	5	800
C	5000	4	1250
D	7000	5.75	1217
E	16000	6.6	2424

As for which households would be affected, we consider three possible scenarios for Areas A, B, C and E (in which proposed expansion of plantations or agriculture are similar).

a) 1% rising to 20% of households over 30 years;
b) 1% rising to 30% of households over 30 years;
c) 1% rising to 40% of households over 30 years;

For Area D, the proposed plantation expansion is much larger (12,000ha) and consequently a larger proportion of households would be affected. We consider the following scenarios:

a) 10% rising to 50% of households over 30 years;
b) 10% rising to 70% of households over 30 years;
c) 10% rising to 90% of households over 30 years;

3.9.2 Results

Based on the assumptions above, we estimate the net present value of preventing sedimentation to range from £3/ha in Area D to approximately £65/ha (£0.25/ha/annum) in Area A. Detailed results for Area A are given in Table 3.12 below.

This range suggests that this value of the forest is a similar order of magnitude to the value derived from non-timber forest products and considerably smaller than the value of carbon storage. Nonetheless, the time costs resulting from increased water course sedimentation may well be perceived as an important issue as these costs are borne directly by local communities.

Table 3.12 - The forest value derived from preventing sedimentation - for Area A

Year	Scenario A Proportion of households affected	Scenario B Proportion of households affected	Scenario C Proportion of Households Affected	Scenario A Shadow-wage-based value of preventing sedimentation CFAF 000	Scenario B Shadow-wage-based value of preventing sedimentation CFAF 000	Scenario C Shadow-wage-based value of preventing sedimentation CFAF 000
00	1.0%	1.0%	1.0%	113	113	113
0	1.6%	2.0%	2.3%	185	223	261
1	2.3%	2.9%	3.6%	257	332	408
2	2.9%	3.9%	4.9%	329	442	555
3	3.5%	4.9%	6.2%	400	552	703
4	4.2%	5.8%	7.5%	472	661	850
5	4.8%	6.8%	8.8%	544	771	997
6	5.4%	7.8%	10.1%	616	880	1,145
7	6.1%	8.7%	11.4%	688	990	1,292
8	6.7%	9.7%	12.7%	759	1,099	1,439
9	7.3%	10.7%	14.0%	831	1,209	1,587
10	8.0%	11.6%	15.3%	903	1,318	1,734
11	8.6%	12.6%	16.6%	975	1,428	1,881
12	9.2%	13.6%	17.9%	1,046	1,537	2,029
13	9.9%	14.5%	19.2%	1,118	1,647	2,176
14	10.5%	15.5%	20.5%	1,190	1,757	2,323
15	11.1%	16.5%	21.8%	1,262	1,866	2,470
16	11.8%	17.4%	23.1%	1,333	1,976	2,618
17	12.4%	18.4%	24.4%	1,405	2,085	2,765
18	13.0%	19.4%	25.7%	1,477	2,195	2,912
19	13.7%	20.3%	27.0%	1,549	2,304	3,060
20	14.3%	21.3%	28.3%	1,621	2,414	3,207
21	14.9%	22.3%	29.6%	1,692	2,523	3,354
22	15.6%	23.2%	30.9%	1,764	2,633	3,502
23	16.2%	24.2%	32.2%	1,836	2,742	3,649
24	16.8%	25.2%	33.5%	1,908	2,852	3,796
25	17.5%	26.1%	34.8%	1,979	2,962	3,944
26	18.1%	27.1%	36.1%	2,051	3,071	4,091
27	18.7%	28.1%	37.4%	2,123	3,181	4,238
28	19.4%	29.0%	38.7%	2,195	3,290	4,386
29	20.0%	30.0%	40.0%	2,267	3,400	4,533
30	20.0%	30.0%	40.0%	2,267	3,400	4,533
		npv (at 10% discount rate)		6,826	9,850	12,874
		npv/ha		6	8	11
		npv/ha/yr		0.18	0.26	0.35

3.10 Option, Bequest and Existence Values

An option value is the value an individual places on the right to use a resource at some future point in time. In contrast, bequest and existence values do not depend on an individual ever expecting to use the resource (such as a forest). There is a considerable body of evidence to suggest that people are willing to pay just to know a "special" environment or particular species exist.

Most of this evidence is drawn from contingent valuation (CV) surveys in the industrialised world. Recently, however, individuals in developing countries ranging from India to Puerto Rico have been surveyed to identify their willingness to pay for environmental preservation. For example, Hadker et. al. (1997) find residents of Bombay willing-to-pay Rs90/year on average to preserve a local national park. This captures both use and non-use values. Pearce et. al. (1993) quoted in Pearce and Moran (1994) estimate option and existence values for Mexican forest of approximately US$7.6/ha per annum.

The CV method is somewhat controversial in a developing country context. Lescuyer and Weber (1997) argue that asking people who generally operate outside a monetary environment to reveal their cash bids for the environment is meaningless. Even allowing people to denominate bids in terms of rice - as done by Shyamsundar and Kramer (1996) - or some other means of exchange may not solve the problem as the cultural context is so important to the answer.

As willing-to-pay results are culture- and environment-specific it is simply too risky to transfer estimates of non-use values to the Cameroon context. An alternative is to consider what governments have actually been willing-to-pay in order to (or attempt to) preserve biological diversity. This approach is not ideal. Flint (1992) notes that donor expenditure on flagship sites may be a poor indicator of general willingness-to-pay. Spending by governments with important logging interests may also reflect something other than a desire to preserve biological diversity.

In the case of the MCP area it could be argued that donor support per hectare is of similar order of magnitude to other areas of similar biodiversity in Africa. Combined DFID/GTZ/GEF funding to the Mount Cameroon Area is approximately £1.5 million per annum. With a hypothetical funding period of 3-6 years and say 300,000ha of forest, this translates into a net present value of approximately £12-£20/ha (£0.4-£0.7/ha per annum) over a 32 year period. This is a similar to the US$16/ha that the World Bank was willing to spend on establishing a forest reserve in Madagascar[17].

Any option, bequest and existence values held by local people for preserving the forest should also be included in the analysis. Spending by the Government of Cameroon on project staff could be taken as an indicator of non-use values at the national level. The difficulty with this is that some of this expenditure is necessary to supervise the use of the forest resource and also reflects government efforts to capture

[17] Grut (1989) reports a figure of US13/ha which we re-state in current prices.

taxes and royalties from timber extraction. Nonetheless, it is the only measure of local non-use value available.

If current levels of local funding are maintained over the next 30 years this component of existence value is estimated at £20/ha. The combined donor and local funding for forest preservation is £42/hectare.

While this is only an approximate value, it is fairly insensitive to changes in the period of donor funding. If, for example, donor funding continued at the existing level for the next 30 years the net present value of the donor component would be £48/ha (with a 10% discount rate) and total non-use value would be £68/ha.

It is important to note that existence values comprise only a small proportion of total economic value in this study (around 3%). Estimates which are based on consumer willingness-to-pay typically produce much higher existence values. Strand (1981) considers the value Norwegians place on protecting their forests from acid rain. Pearce and Turner (1990) interpret his results as 60% existence value and 40% use value. In a similar vein, Gutierrez and Pearce (1992) estimate the total economic value of tropical forest in the Brazilian Amazon: 16% arises from direct use, 51% from indirect use and 33% from existence values.

If existence values for the forest in the MCP area were to reach this level it would imply something like a doubling of the estimated total value of sustainable forest use. Yet even in this case the ranking of alternative land-uses would not change in any of the areas considered. Sustainable forest use always produces higher value than expanding plantations but has a lower economic value than using the land for Chop farming.

4. Allocating costs and benefits by stakeholder

Table 4 below apportions the costs and benefits of alternative land use options in Area A to the various stakeholders/recipient groups. The allocation by recipient group will be similar for other areas but the net returns per farmer or villager will vary according to how many there are in the area. Returns to local farmers in Areas C and E will also include a component for harvesting Prunus africana. At current prices, the gross financial return to local villagers is in the order of £4/ha (which is, of course, a small proportion of the economic return to the resource).

All figures are in financial terms to include taxes which means the figures for some costs and benefits will not be the same as those discussed in the previous section. We have also assumed that:

- only 10% of rents from discovering plant-based drugs in the forest area would accrue to the Government of Cameroon (GoC). Ruitenbeek (1989) makes this assumption for Korup and little has changed since then to suggest a higher proportion of returns from any discovery would be captured nationally.
- the tax revenues and lease charges paid by CamDev to GoC are offset by financial support to cover losses. If the industry were private, government revenues would still be small as we forecast pre-tax losses from plantation expansion.
- there is no direct impact on local farmers if plantations are extended. In practice, some will gain as new plantation workers will pay rent for their own Chop-farms. This rent will vary from area to area. Additional plantations allow some local people the opportunity to move from full-time farming to a mix of part-time farming and salaried work. This is popular as it diversifies income sources and allows two effectively part-time jobs to be combined. What we do not know is the proportion of **local** people who gain from this - rather than immigrants from other areas. Plantation expansion also reduces the welfare of those farmers who have (illegally) planted on the margins of the existing plantation and who lose their land when plantations are enlarged. Modelling these complex and area-specific impacts has not been possible in the time available for this study; and
- CamDev pays the same rent what ever the use of the land. This is the case now but could change in future. If the alternative to plantation expansion was a lower lease payment, CamDev would be relatively better off and GoC would lose this payment.

The conclusions from this section explain why the pressure to clear forest land remains high even though society as a whole is worse off as a result. Specifically, we note that:

- Chop farming produces the highest returns to local people. The direct financial returns outweigh the indirect losses from increased flooding and sedimentation of water courses - all of which are borne by local people. The current rate of land conversion is therefore not surprising. As Chop farms do not produce tax revenues or consume subsidies there is no obvious impact on the GoC. The loss of carbon storage when forest is converted into farm land is currently a cost borne by the global community but could become lost national revenue if a carbon offset deal was a realistic alternative;

Table 4 - Allocating total financial net benefits by stakeholder – Area A

Chop farming - npv/ha - £/ha

	Local farmers	CamDev	GoC	Nationwide	Global
Direct use value – chop	1,047			1,047	1,047
NTFPs	18			18	18
Value of carbon storage				0	420
Undiscovered plant-based drugs			(0.1)	(0.1)	(1.4)
Flood prevention	0			0	0
Preventing sedimentation	(8)			(8)	(8)
Non-use value (option, bequest, existence)			(30)	(30)	(62)
Total	1,057	0	(29.8)	1,027	1,413

Plantation expansion npv/ha - £/ha

	Local farmers	CamDev	GoC	Nationwide	Global
Direct use value – plantations		(2,713)		(2,713)	(2,713)
NTFPs	6			6	6
Value of carbon storage				0	487
Undiscovered plant-based drugs			(0.1)	(0)	(1.4)
Flood prevention	0			0	0
Preventing sedimentation	(8)			(8)	(8)
Non-use value (option, bequest, existence)			(30)	(30)	(62)
Total	(3)	(2,713)	(29.8)	(2,746)	(2,293)

Sustainable forest use npv/ha - £/ha

	Local farmers	CamDev	GoC	Nationwide	Global
Direct use value – timber	6		111	117	226
NTFPs	26			26	26
Value of carbon storage				0	1,391
Undiscovered plant-based drugs			0.1	0.1	1.4
Flood prevention	0			0	0
Preventing sedimentation	8			8	8
Non-use value (option, bequest, existence)			30	30	62
Total	41	0	140.7	181	1,715

- Sustainable forest use produces modest cash returns to local people from timber extraction taxes and, in certain areas, payment for collecting Prunus africana bark. Local people also gain non-cash, benefits from forest protection of soil and river water quality. If a higher proportion the economic rents obtained from Prunus africana bark accrued to local people rather than the exporting companies and GoC/officials concerned, the financial return to sustained forest use could easily exceed that from chop farming, at least in the Upper Villages area.
- The GoC is theoretically the major beneficiary of tax revenues (central government and council taxes notionally account for around a third of gross revenues). Actual tax collection rates are reportedly somewhat less than this notional level. As noted previously, the gains from carbon storage in the forest currently flow to the global community rather than the GoC. Net revenues are taken to accrue to the exporting company and are shown as global rather than

national benefits. This understates national benefits as some profits would be retained nationally and there would also be a national gain from employment in the industry;

- Plantation expansion is likely to bring benefits to some local people and impose costs on others. As noted above, we do not have sufficient information to say whether the local community as a whole would be net losers or gainers. The principal losses which result from plantation expansion are borne by CamDev and the nation as a whole.

5. Areas Requiring Further Economic Research

5.1 Prunus africana

A number of important economic issues remain to be addressed. These include:

- Undertaking an accurate assessment of the economic costs and benefits of the processed herbal product. At a practical level this information is necessary to infer what local communities involved in sustainable harvesting can reasonably expect to earn.
- Developing incentive compatible schemes to lower the risks associated with planting P. africana on farm thereby encouraging its cultivation.

5.2 Chop farm agriculture

Areas identified in this report as requiring further research include:

- Options for encouraging the intensification of agriculture. The relevance of agro-forestry-based systems such as "alley cropping" as well as "no-till" systems need to be investigated for the MCP area.
- The role of chop farming in the broader livelihood strategy pursued by various socio-economic groups in the region. This is particularly important if farmers are to be offered financial incentives to switch to farming systems which are less threatening to the forest.

5.3 Developing new sources of forest value

Project staff have already identified rattan cultivation as a promising means of developing local incomes at the same time as adding value to conserving the forest. An overview of the scope that rattans may offer is indicated in the note attached as Annex 6. What is lacking so far is a financial and economic analysis of the costs and benefits of rattan cultivation and processing as well as an indication of who would benefit from this.

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Annex 1

Ambrose-Oji, B. , Acworth, J., Abonge, G., Oji, G., and Manga, H., Rapid Agricultural Survey - Methodological Note, MCP Limbe, 1998.

The Rapid Agricultural Survey (RAS) was conducted in 8 settlements, across five geographical working areas in the MCP project region from October 1997 to January 1998.

The objectives of the survey were to:
1. identify and classify farming systems in the project area
2. determine the average farm size by farming system and farmer characteristics across different geographical working areas
3. determine average yields of the most important crops grown in the five geographical areas
4. determine the costs and revenues associated with different farming systems in each area
5. determine the location and size of the area of land classified as farmland or farmbush within each of the five geographical areas

The survey methodology consisted of four discrete but linked activities
1. RAS questionnaire based survey
2. Farm visits
3. Focus group discussions
4. Market visits

RAS QUESTIONNAIRE

Initially the RAS questionnaire was based heavily on that developed by Rew et al (1997). After half a days enumeration training with MCP community development staff, a pilot test was conducted in Bakingili village during a three day stay. The questionnaire sheets were then modified following a days debriefing and discussion of field problems. Field teams of 3 project staff working alongside local agricultural extension workers, then spent three days or more in each of the surveyed settlements, interviewing members of around 20 households per settlement. The random household sample was stratified by ethnicity, age and gender of household head, wealth category, and farming system. This information was provided by agricultural workers and from past MCP data. All the major farming systems found in an area were represented in the survey data.

Respondents were asked to state clearly if they were answering for themselves alone or the household as a whole. A total of 124 questionaires were completed without error.

Survey questions concentrated on recording the number of plots actively farmed or fallowed by households, farmer estimated farm plot sizes and yields of the most important crops as harvested over the previous farming year. Quantities were recorded in local units of measure which were later calibrated in the market survey, and revenues given were either by actual income earned at the farm gate or local market or, if produce was used for household subsistence, by local market prices.

Additional questions documented household use of labour for farming and other tasks associated with farmbush and forest, livestock holdings, and farmer perceptions of the effects of possible plantation expansion.

FARM VISITS

These followed on from a rapid analysis of the questionnaire results in the field. Four small or medium scale farmers considered to be 'representative' of the different farming systems encountered were selected. A morning's field visit to one farm plot with the field team and the farmer recorded more detailed information labour demands, crop yields, revenues, and the costs of farming i.e. rents, clearing and weeding, planting and other material inputs including hired labour, all of which were specific to that particular parcel of land. Once again all quantities were recorded in local measures.

Measurements of the farm plots to give an accurate estimate of area, used the methodology described by Poates and Daplyn (1993; 116-117). A total of 26 visits were conducted successfully.

FOCUS GROUP DISCUSSIONS

At the end of the three day stay a focus group discussion was held with between 6 and 10 farmers. Groups of male and female farmers were invited to meetings and PRA exercises conducted with each independently. The purpose of the FGD was twofold;

1. To perform matrix ranking exercises to rank and score the most important economic crops for males and females - this was to form a check on the data collected in the RAS;
2. To perform a participatory mapping exercise to locate the areas of farmland around key settlements - this was to add to existing MCP inventory and other knowledge to form a more complete picture of the total area of land put down to farming in each of the five zones;
3. A semi-strucured discussion clarifying information about farming costs and marketing information - again to form a check to the RAS data.

MARKET SURVEY

The primary purpose of the market survey was to calibrate and quantify local units of measure and common units of trade. The survey recorded kilograms values for all of the most common units; the average of 4-5 measurements using a spring balance was taken as the average mass. A market survey was conducted in the Mokoko area and at Limbe market. Values for other markets were taken from previously collected GEF socio-economic survey (SES) data (Ambrose-Oji, 1997). Average retail prices for major products were calculated assuming a median value between the highest and lowest seasonal price. Supplementary data for 'minor' products was provided by the GEF SES data.

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ANNEX 6

Abstract of project proposal for the development of African rattans as a crop of economic importance

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Subject review

Rattans are climbing palms belonging to the subfamily Calamoideae, the scaly fruited palms (Dransfield and Uhl,1986). There are about 600 species in 13 genera. Of the 13 genera that make up, the rattan, three genera namely *Eremospatha, Laccosperma,*(formally *Ancistrophyllum*) and *Oncocalamus* are restricted to the rainforest areas of Africa. The large genus *Calamus* is represented in Africa by one species(Uhl and Dransfield,1987). The remaining rattans are all found in Asia, Malaysia and the western Pacific.

Though rattans play a very important role in the local economies of most West and Central African countries, they have been almost completely neglected by the scientific community , forestry institutions and official legislation. The taxonomy of African rattans at and within the species level remains confused and even less is known about their ecology. Little is known about their trade internationally and there has been no large scale attempts at silviculture, in contrast to the situation in SE Asia.

In spite of this neglect, the rattan cottage industry in Africa has thrived due to the escalating demand for rattans domestically and internationally. Cane furniture can be found in most African cities with an unknown amount being exported to countries such as Japan (Komolafe 1992). Raw unprocessed rattan is also being exported from W. Africa to Asian countries such as China which have been forced to look further afield for their supplies due to over-exploitation in their own countries and the ban on the export of raw cane by the Indonesia and Malaysia, their main supplies before 1987(Xu 1987).

The future of rattan industry is becoming concerned about the increasingly scarce and irregular supplies of raw material . This a major cause for concern , particularly in view of the scarcity of information on African rattans. Several species of rattans are now suspected to be endangered in parts of their ranges before any framework for conservation can be devised.

A long term solution to the problem of supply would be large scale planting of rattans through agroforestry, enrichment planting of forest reserves, and effective management of wild rattan growing in natural forest. However, this requires knowledge of biology, ecology, germination and growth of commercial species.

World Value of Rattans

Majority of rattan species occur in SE Asia ,Malaysia and the Pacific, where they are the resource base for the cane industry that is estimated to be around £4 billion annually (Manokaran,1990) Much of the cane entering world trade is of wild origin and with intensive logging activities and associated increases in Forest conversion, shortages of rattan became apparent in early 1970's and the forest departments in SE Asian began to investigate the possibilities of commercial rattan cultivation. The first steps taken towards this aim resulted in a complete inventory of wild Malaysian rattan and the establishment of research plots that have been used to determine optimum conditions and subsequent guidelines for the cultivation of rattans(Dransfield and Manokaran,1992). Commercial plantations have been established in Sarawak, Sabah, the Philippines, Indonesia and Papua New Guinea.