Enhancing the Role of Non-wood Tree Products in Livelihood Strategies of Smallholders in Semi-arid Kenya

Executive Summary

This research project investigates different aspects of the use, values and potential of tree products to smallholder farmers in Tharaka in eastern Kenya. In this region rural livelihoods are vulnerable, agro-climatic conditions are uncertain, infrastructure and services are poorly developed. Cropping is a risky undertaking and smallholders seek various means to diversify and secure their livelihoods. Tree products can play a key role in achieving these objectives.

The research has four aims. First, to investigate the uses of tree products to smallholders. Second, to use innovative research techniques to quantify and assess the range of values of tree products and forests to farmers. Third, to identify means of maximising and capturing these values within the livelihood constraints. Fourthly to develop and disseminate interdisciplinary approaches to this assessment.

Tree products are valuable to farmers in Tharaka primarily for their subsistence values. Households also value forest reserves for a number of non-material uses, and there are traditions of cultural values and heritage associated with trees and forests. Such values are often overlooked in conventional analysis of income and livelihoods, but the method we adopt identifies and quantifies these. Market surveys show that income is generated through the local sales of a variety of tree products, the most important being honey and furniture. However few people make more than supplementary income from sale of tree products and the production of value-added tree products to supply these markets is not well developed.

The research identified two species which can successfully be incorporated into existing farming systems and which could add value and generate income for farming households. *Melia volkensii* provides useful products for subsistence use, fodder and timber, and also products for sale, timber and carving wood. It is adapted to the local conditions, fits with the farming system, and provides subsistence and cash products at critical times of the year. The fruits of *Tamarindus indica* have regional markets in Kenya and are also exported. The fruit are harvested and sold towards the end of the dry season when few other sources of cash exist. Farmers have very poor access to information or to support in terms of credit or transport and this makes them powerless in choosing when and how to market tamarind. Overall, lack of credit and technical and market information about trees is a major constraint to farmers wishing to expand their income and production base in tree products.

In addition to providing a wealth of empirical data on the role and values of tree products in smallholder livelihoods the findings of this research make a significant contribution to knowledge and understanding in three areas of natural resources and development studies. These are: the role of trees and tree products in rural livelihoods; the incentives for smallholder farmers to invest in trees and thus conserve forest biodiversity in semi-arid regions; the development of methodologies which combine economic valuation within the framework of people's own perceptions and livelihoods. This report discusses the implications of the research findings and makes a number of recommendations for target institutions.

Background

Rural livelihoods are vulnerable in the arid and semi-arid lands (ASAL) of Kenya. Agroclimatic conditions are uncertain, infrastructure and services are poorly developed, and sources of subsistence are limited with there are few opportunities for generating cash income. The majority of households are poor in absolute terms, and lack opportunities to expand or improve their resource base. Evidence suggests that tree products make a major contribution to the livelihoods of the poor in these semi-arid regions; they provide both subsistence items and cash income, and have been demonstrated to play an especially important role for poorest and women farmers. Most cash income is obtained from a few wood products, particularly charcoal and polewood, and there are currently poorly developed markets for many other tree products. Where sales of tree products take place, the vast majority of income accrues to middlemen and professional marketing bodies rather than to the farmers who grow them. Farmers realise low rates of income from trees because there is only a small value added at the household level, the prices they receive are low and markets in tree products are undeveloped. This research is undertaken on the premise that there is potential for the development of tree products for sale, and for the development of small-scale local-based processing and marketing. This need has been identified as a priority by farmers themselves as well as by government, research institutes and donor agencies.

The need for research has been stimulated by three major gaps in current theory and practice:

- Kenyan markets in tree products are focused on wood-based items and large-scale commercial enterprises. Little is known about the current or potential economic value of non-wood and other tree products as a means of income-generation for poorer households in marginal areas. Farmers lack access to market and technical knowledge about tree products.
- Conventional economic valuation has largely ignored non-wood tree products and there is a dearth of information about their values and uses in ASAL Kenya.
- Farmers living in marginal dryland areas, especially poorer households and women, have few sources of sustainable income within the context of their existing livelihood systems.

The research aimed to address these issues, and to inform a number of information gaps. Although major theoretical developments have taken place in environmental valuation over the last decade, in the forestry sector these developments have usually focused on valuing commercial timber production and the ecological functions of forests (Adger et al., 1995; Brown, 1994; Kumari, 1995). There has been relatively little research in rural developing economies into the value of tree products or their exploitation for the market. This has hindered the commercial development of tree products and marginalised their important role in rural livelihoods. Recent work in Kenya (Emerton, 1996; Emerton and Mogaka, 1996) has developed economic methods for valuing subsistence forest use. This research builds on these findings and extends conventional economic valuation techniques. It provides methodological innovations for valuing tree products use by adopting a participatory approach to environmental valuation (PEV). This technique reveals uses and values often overlooked by conventional ethnobotanical analysis, and by economic analysis, which does not take account of farmers' own perceptions and often undervalues subsistence and other non-

market uses. The changing policy context in Kenya (see Appendix 3) provides an ideal opportunity to examine the ways in which tree products can make a greater contribution to rural livelihoods and whether this might in turn also provide incentives for more sustainable tree and forest management.

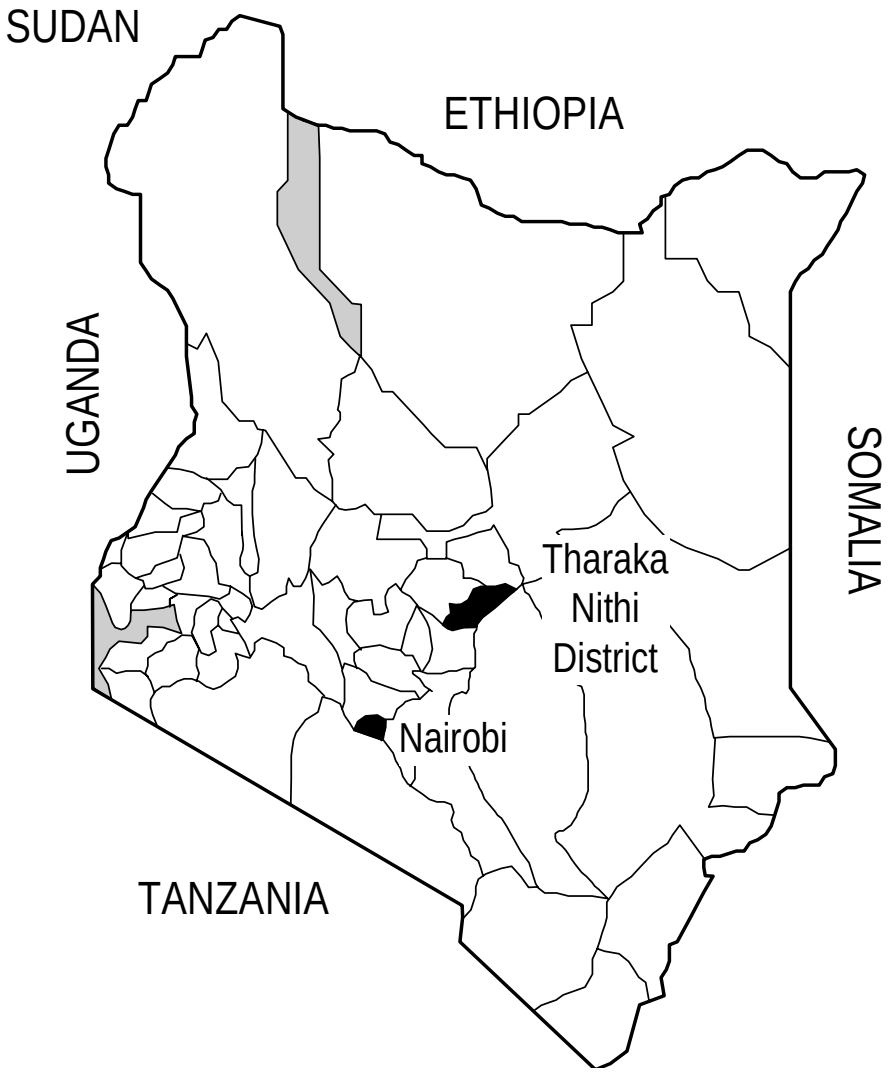
Appendix 1 provides further information on the methods and the assumptions underlying the study, and Appendix 4 gives detailed rationale for the use of Participatory Economic Valuation techniques and their application in subsistence economies such as those of smallholders in Tharaka. Appendix 2 discusses some of the wider conceptual issues concerning smallholder tree management and Appendix 3 outlines the policy context for tree and forest management in Kenya.

Geographical setting

Tharaka District contains a range of socio-economic, agro-ecological and marketing conditions. It is used as a case-study to demonstrate the use and value of tree products in rural livelihoods and markets. From previous experience, the researchers identified Tharaka as marginalised ASAL area; remote from large commercial markets, where there is great demand for more secure livelihoods. Figure 1 shows that Tharaka is located about 200Km northeast of Nairobi.

When this research started in 1996 Tharaka was part of Tharaka-Nithi District. In 1998 a new district, Tharaka was created, comprising the lower divisions of Tharaka-Nithi District. Tharaka District equates to the area we refer to as Tharaka. This region covers an area of 2 295 km^2 and there are approximately 92 000 people, or 18 500 households living there. Plate 1 shows the typical landscape and the fallow farming system with extensive burning before planting. Appendices 1 and 2 provide further details about the agro-ecological, economic, social and cultural context of this research.

Figure 1: Location of the study site, Tharaka, Kenya



Project Purpose

The overall purpose of the project is to identify new and improved markets for tree products through the valuation of non-wood tree products and assessment of opportunities for improved markets. The project thus sought to identify tree products which can add value and enhance livelihoods of smallholders in semi-arid Kenya.

The research has four aims:

1. Investigate the use of tree products by smallholders;
2. Demonstrate the values of tree products to smallholders and develop methods for valuing them which reflect a wide range of values including subsistence, cultural and others;
3. Identify ways of capturing and maximising the value of tree products for farmers by identifying products with potential markets and investigating practical means of marketing and processing tree products which will add value at the household level and meet local, regional and national demands;
4. Contribute to the available body of literature on tree products by generating interdisciplinary information about tree products use and providing replicable models and recommendations for assessing, valuing and developing tree products use.

This research quantifies the value of key tree products in supporting livelihoods in semi-arid production systems and identifies two products which have potential for market and income generation. The research used a range of participatory methodologies which investigated farmers' perceptions, knowledge, access and values of these products. Information generated by the research will be used to inform local development and extension strategies, national and international research and government and non-government development agencies. This information will help to enhance income generating prospects for households in semi-arid regions and support the formulation of policy to provide incentives for the more effective management and conservation of trees.

Research Activities

Table 1 shows the project activities as specified in the LogFrame and their current status. All project activities are complete, with the exception of Activity 6 which includes on-going dissemination activities. Table 1 also indicates where in this report further details of the activities are described.

Table 1: Project activities as specified in the LogFrame

Activity	Status
1. Community consultations to assess resource endowments, needs, knowledge and tree management systems	Complete; findings synthesised and discussed in Appendix 1; used to identify sites for surveys, participating farmers and communities and to inform the surveys reported in Appendices 5,7
2. Participatory Rural Appraisal methods used to identify key non-wood tree products, access and management	Complete: used to focus surveys detailed in Appendices 5,7,8
3. Valuation exercises and household surveys to assess values of key non-wood tree products and identify products with marketing potential	Complete; findings in Appendices 5,7 and summarised in sections 1 and 3 below
4. Field marketing and technical surveys for key resources	Complete; findings in Appendices 7,8 and summarised in sections 2 and 3.
5. Assessment of markets outside ASAL to explore commercial opportunities for NWTP identified above	Complete: findings in Appendix 8, summarised in section 3.
6. Dissemination of findings to target institutions and commercial interests and academics	On-going – see sections 4 and Appendices 4,5,3 and concluding section of this report.

Outputs

Table 2 summarises the research outputs according to the Logframe. The findings of the research are outlined in the next three sections. These focus on smallholder uses and values of tree products and forest reserves in Tharaka; markets for tree products in Tharaka; and adding value to tree products.

Table 2: Research Outputs specified in the LogFrame

Research output	
1. Methods and measures for assessing the value of tree products in household production and livelihood in relation to household needs and priorities	Participatory economic valuation techniques were successfully applied; details of the techniques in Appendix 4 and of their application in Appendix 5.
2. Understanding of local technical knowledge, practice and policy relating to management and use of tree resources	Contextual issues relating to tree use and livelihoods discussed in Appendices 1 & 2, policy analysed in Appendix 3.
3. Identification of high value NWTPs and markets	Household surveys and community consultations identified two species. They are discussed in Appendices 6 & 7.
4. Identification of marketing channels and means of increasing share of value of NWTP captured by smallholders	Market survey reported in Appendix 7.

Research findings

1. Smallholder uses and values of tree products in Tharaka

Community consultations, PRA and PEV exercises and household surveys were used to investigate the uses and values of tree products to smallholders in Tharaka. This section summarises the findings, which are discussed in more detail in Appendix 5. Aspects of the methodology utilised are also explained in Appendix 4.

Characteristics of smallholder livelihoods in Tharaka

Smallholder livelihoods in Tharaka are based on subsistence farming in an area of very uncertain rainfall and poor conditions for continuous rainfed cultivation. Table 1.1 shows the characteristics of respondents to our household survey, and further features of Tharaka livelihoods are described in Appendices 1 and 2.

Table 1.1: Socio-economic characteristics of the survey region

Variable	Mean
Household size	7.8
Age of respondent (yrs)	50.1
Land size (acres)	15.7
Land under cultivation (acres)	6.0
Land for pasture (acres)	9.7
Number of cattle	5.6
Number of shoats	11.6
Total livestock	17.6

Based on the survey data, the average annual income per capita in this area is estimated at Ksh.4,796 (US$80)[1] and the majority of the households depend on livestock production, agriculture and forest resources. Employment and remittances from family members account for over 57% of total income but less than half of the total households rely on it. Forest and tree products play and important role as a source of income. Although forest products contribute only a mean of 4.4% of the total household income, a very large proportion of households depend on these resources (about 81.5%), as shown in Table 1.2.

[1] At the time of this survey the exchange rate was 60KSh. = US$. This rate is used throughout this report.

Table 1.2 Income of surveyed households

Source	*Income*		*% total income*	*% households*
	Ksh '000	***US$***		
Employment/remittances	1,409	23,483	57.8	44.6
Livestock	597	9,950	24.5	100.0
Agriculture	201	3,350	8.3	96.9
Business	123	2,050	5.1	15.4
Tree products	108	1,800	4.4	81.5
Total	2,438	40,633		
Mean per household	**38**	**633**		
Mean per capita	**5**	**83**		

Existing tree use in Tharaka

There is a long history of indigenous tree use in Tharaka, and some species have been domesticated over time through farm forestry (Blomley *et al* 1991a, 1991b). Many of the trees planted on farms – or left on farms after bush clearing – have multiple uses, such as *Tamarindus indica* (muthithi), whose fruits are sold locally and supplement farm income, whose branches provide shade for animals, crops and people, leaves provide green manure, which is used to hang beehives and bark and is widely used for human medicine.

Trees have a high livelihood value in Tharaka because they provide support to household subsistence. The value of tree products in Tharaka extends beyond their direct uses. Tree products generate vital support to livelihoods by producing goods for fuel, shelter and food which are unavailable or unaffordable elsewhere for many households. They also support agriculture – the basic means of production for most of the population – through providing goods such as manure and fodder as well as helping to improve on-farm soil conservation and productivity.

Trees also form a source of insurance and fallback. As is the case in many other parts of dryland Africa (see Barrow 1996), they are used as contingency measures, and increase livelihood resilience in the face of risk and uncertainty. In an uncertain environment, Tharakan livelihoods are characterised by the interdependency and substitutability of different elements of production and consumption. As particular sources of food, fodder and fuel become scarce over the year as a result of drought, lack of cash or crop failure, a variety of fallback sources are used to substitute and supplement for scarce or missing goods. Many of these alternative or substitutes come from trees. For example wild fruits provide drought foods when crops fail, leaves and pods provide livestock fodder when there is no pasture. This influences the choice of trees which are maintained or planted on people's farms, many of which are multiple use trees and can simultaneously generate a range of subsistence products.

The following sections present the findings of household surveys (described in Appendix 5) which examined the use and values of tree products associated with two of the six forest reserves in Tharaka, Kijege and Ntugi. The location of the reserves is shown in Figure 1.1 and Plate 2 shows Kijege Forest Reserve which consists of hill-top woodland.

Figure 1.1 Forest reserves in Tharaka

Value of forest reserves to Tharaka smallholders

Table 1.3 indicates that a vast majority of Tharakan households are engaged in one or more forest activities. However most of these activities contribute towards maintaining subsistence and only a minority are income generating.

Table 1.3: Household involvement in forest-based activities

Forest product/amenity	*HHs involved in subsistence use*		*HHs involved income-based activities*	
	Number	*% of HH*	*Number*	*% of HH*
Timber	22	33.9	10	15.6
Poles/Posts	51	78.5	30	46.9
Honey	24	36.9	14	21.9
Bee-hives	19	29.2	12	18.8
Thatch grass	42	64.6	22	33.9
Baskets	14	21.5		
Ropes	10	15.4		
Bows and arrows	11	16.9		
Chairs	13	20.0		
Hats	6	9.2		
Walking sticks	9	13.9		
Grazing	33	50.8		
Wild-meat	22	33.9		
Withies	35	53.9		
Firewood	26	40.0		
Reeds	15	23.1		
Medicines*	16	24.6	16	24.6
Climate amelioration	16	24.6		
Watershed protection	14	21.5		
Knowledge-base	18	27.7		
Cultural role	14	21.5		

*Due to the valuation technique used for deriving the value of medicines, it was not possible to clearly disaggregate subsistence and income-based, but all the traditional healers offer treatment both for free and for cash depending on the nature of disease.

Based on the number of beneficiaries, the most important products procured from the forest include, poles or posts, thatch grass, withies and firewood for meeting subsistence needs. According to the number of households engaged in at least one forest activity forest benefit flow is widely distributed across local community.

An examination of locally declared forest benefits can be classified also according to the main objectives they fulfil within the household economy. On this basis, three broad categories are derived; objectives related to meeting subsistence needs, as a declared source of cash-income and for non-use or existence values (Table 1.4). The relative proportion between these categories has a number of implications for long-term forest conservation. This shows that a relatively high proportion of local households who recognise the forest for its non-use and existence values. A major factor that shifts local people's perceptions of the value of tree resources is related to

the changing economic demands. Significant external demand for forest products shifts local people's perceptions of forests from that of supporting subsistence, to support wider household production and consumption activities. In the case of Ntugi-Kijege the latter has been restrained by poor infrastructure and weak linkage with other urban market centres.

Table 1.4: Use and non-use values of Ntugi-Kijige forests

Use type	*% of HHs*
Subsistence uses	95.4
Source of income	81.5
Non-use/existence value	40.6
No preference	4.6

The forest reserves support local livelihoods in a wide range of ways. These include providing food, construction materials, fodder and grazing, fuel, medicines and other materials. Table 1.5 shows the annual economic value of these subsistence uses and Table 1.6 the annual economic value as income derived from the forest reserves. These data show that the subsistence value of forest products is about five times greater than the cash values. Further details of the derivation of these figures can be found in Appendix 5.

Table 1.5: Annual value of the reserves as source of subsistence uses

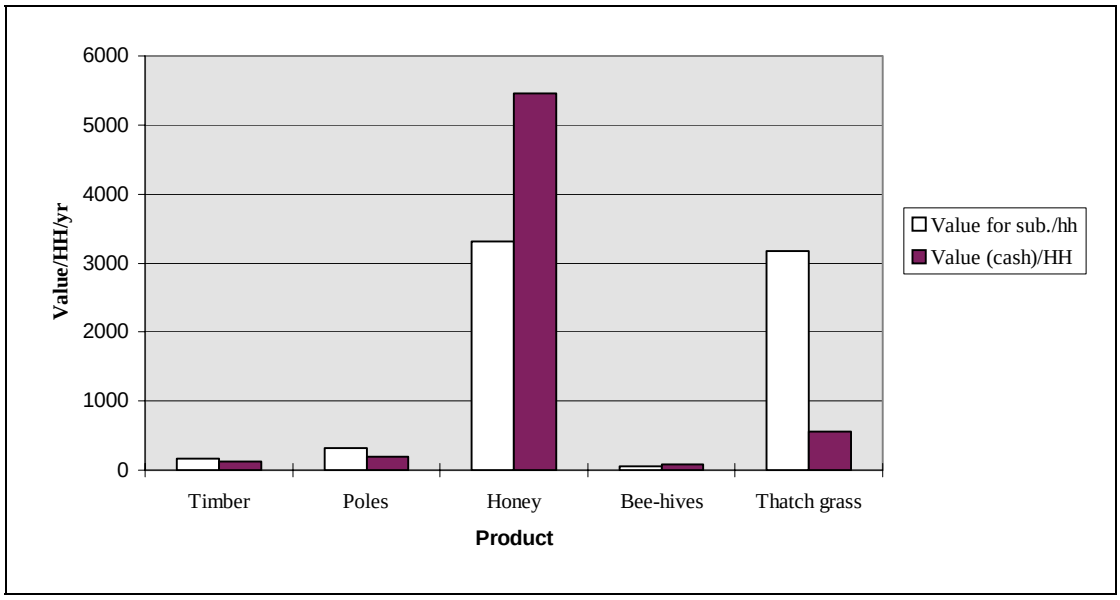
Forest product	*Units*	*No. extractors*	*% HHs*	*Total quantity*	*Net economic value/HH/yr KSh.*	*Net economic value to community/yr '000 KSh*
Grazing	TLU	660	51	3,489	5,736	3,786
Timber	Planks	440	34	8,740	167	74
Poles/posts	Single poles	1020	78	213,400	325	332
Honey	Kgs	480	37	14,000	3,318	1,593
Bee-hives	Sets	380	29	900	54	20
Wildmeat	Kgs	440	34	1,300	2,466	1,085
Withies	Bundles	700	54	16,960	70	49
Firewood	Headloads	520	40	51,480	773	402
Reeds	Bundles	300	23	29,040	69	21
Thatch grass	Headloads	840	65	68,327	3,171	2,663
Total						**10,024**
Annual value/ha '000KSh						**2.1**

Table 1.6 Annual value of reserve as a declared source of income

Forest product	*% of HHs*	*Net economic value/HH/yr KSh*	*Net economic value for community/yr '000 KSh*
Timber	15	123	24.5
Poles/posts	43	188	105.5
Honey	22	5,454	1,527.1
Bee-hives	17	86	18.9
Baskets	22	88	24.7
Ropes	15	170	34.0
Bows & arrows	17	120	26.5
Chairs	20	171	44,350
Hats	9	151	18.1
Walking sticks	29	8	3.2
Thatch grass	51	556	366.7
Total			**2,193.5**
Average value/ha KSh			**468**

Figure 1.2 shows the economic values of five forest products to households. Honey and beehives are two products which are especially important sources of cash; however their subsistence values are also high to individual households.

Figure 1.2 Household forest values for subsistence and cash income



In addition to subsistence and cash income or direct uses, the forests represent other values to Tharakan smallholders. Table 1.7 shows the indirect and existence values of the forest reserves. The values per hectare derived from the household surveys indicate that these values are comparable with the income values. These data were derived using the contingent and pair-wise ranking procedures outlined in Appendices 3 and 5. They show that Tharakan farmers appreciate and value the forests for a wide

range of functions, services and cultural reasons. These values were found to vary significantly according to respondents' age, indicating that peoples' perceptions of forest may be changing in response to prevailing social, economic and cultural pressures and norms (see Appendix 5). Generally Tharakan households increasingly view the forest as an economic resource for exploitation, and younger respondents put less value on the forest as a knowledge store or for its intangible cultural roles.

Table 1.7: Indirect and existence value of Ntugi-Kijege reserves

Type of value	*% of HH*	*Average value/HH/yr KSh*	*Total value to community/yr '000 KSh*
Medicines	24.6	2,005	641.5
Climate regulation	27.7	1,007	362.4
Watershed protection	21.5	1,317	368.8
Knowledge source	27.7	1,467	528.0
Cultural role	15.4	1,388	277.6
Total value ('000 Ksh)			**2,178.4**
Value/ha (Ksh)			**465**

Table 1.8 aggregates the data from the survey to estimate Total Economic Value of the forest reserves. This shows that subsistence values are most important. It also takes account of the costs associated with the forests. Thus the community and society in general incurs costs associated with managing the reserves and also as a result of productivity losses (detailed in Appendix 5). However the net benefits of the forest reserve are still considerable, in excess of 10 million KSh per annum a significant proportion of which accrues to local communities and supports smallholder livelihoods.

Table 1.8: Total Value of Ntugi-Kijege Forest Reserves

Type of value	*Average value KSh/ha*	*Total value '000 KSh*
Subsistence	2,138	10,024
Source of income	468	2,194
Indirect & existence	465	2,178
Government revenue	0	0
Direct management cost	-372	-1,744
Productivity loss	-419	-1,965
Opportunity cost	0	0
Net value		**10,687**
Net value/ha	**2,279**	

In summary these data suggest that smallholder livelihoods in Tharaka are precarious. Tree products from trees on farms and from forest reserves are important to subsistence and fulfil a number of important roles. Tharakan households also acknowledge a range of other values in forests and trees, including intangible values such as cultural roles, and other indirect and existence values. There is some evidence that this is changing and that younger sections of the population are more orientated towards the role of forests as sources of cash. As yet, tree products and forest reserves contribute only a small fraction of household cash.

2. Marketing of Tree Products in Tharaka

Two of the main weekly markets in Tharaka, located in Marimanti and Gatunga (see Figure 1.1) were monitored over a period of 20 months to assess the types of tree products sold, the nature of the market and vendors. The rationale and the survey forms used for this part of the study are presented in Appendix 1.

Tables 2.1 and 2.2 show the characteristics of the tree products for sale in the two markets.

Table 2.1: Market characteristics for sales of 12 tree products at Marimanti market (September 1997-April 1999)

Product			No. of vendors		Volume of sales		Price	
	Season length (months)	Period	Max.	Min.	Max. (sales per week)	Min. (sales per week)	Max. (KSh per unit)	Min. (KSh per unit)
Honey	12	Year round	8	1	60	0	130	20
Beehives	9	Oct – May	3	1	5	1	500	200
Charcoal	8	Sept-May	3	0	7	0	160	100
Chairs	12	Year round	3	1	2	1	120	30
Gourds	2	May-June	2	1	8	1	80	10
Walking sticks	9	Sept-June	1	0	10	0	160	20
Bows	5	Feb-July	2	0	7	0	65	10
Arrows	12	Year round	2	0	8	0	26	3
Ropes	12	Year round	6	1	70	10	35	15
Hats	9	Sept-June	3	0	18	0	28	8
Mats	12	Year round	10	4	150	10	55	25
Baskets	12	Year round	3	0	30	0	52	12

Notes:

Data based on observations of 12 products for 19 usable data points (months) September 1997-April 1999. Initial pilot survey of Marimanti market in August 1997 not included.

Data were also collected on medicines and fruits but were unreliable.

Market season describes period where transactions regularly occur. Occasional months within the season may have no transactions (hence minimum vendors and minimum transactions can be zero).

Table 2.2 Market characteristics for sales of 12 tree products at Gatunga market (September 1997-April 1999)

Product	Season length (months)	Period	No. of vendors Max.	No. of vendors Min.	Volume of sales Max. (sales per week)	Volume of sales Min. (sales per week)	Price Max. (KSh per unit)	Price Min. (KSh per unit)
Honey	12	Year round	9	0	400	0	130	50
Beehives	7	Sept–April	3	1	7	0	420	150
Charcoal	8	Sept-May	3	0	5	0	120	110
Chairs	12	Year round	3	1	2	1	220	70
Gourds	0	-	0	0	0	0	-	-
Walking sticks	8	Oct-June	1	0	8	0	50	10
Bows	5	April-Aug	2	0	5	1	55	15
Arrows	12	Year round	2	0	14	1	40	5
Ropes	12	Year round	6	1	85	0	32	15
Hats	9	Sept-June	3	0	35	0	32	8
Mats	12	Year round	10	4	120	0	60	28
Baskets	12	Year round	3	0	20	0	30	5

Notes:

Data based on observations of 12 products for 19 usable data points (months) September 1997-April 1999. As with Marimanti, an initial pilot survey of Gatunga market in August 1997 is not included.

Data were also collected on medicines and fruits but were unreliable.

Market season describes period where transactions regularly occur. Occasional months within the season may have no transactions (hence minimum vendors and minimum transactions can be zero).

These data highlight some of the important characteristics of the local markets for tree products in Tharaka; their seasonality, the number of vendors, volumes of sales and price variations. Some products are traded throughout the year whereas others have marked seasonality. Honey, chairs, arrows, ropes, mats and baskets are sold all year round, but beehives, charcoal, gourds and calabashes are seasonal. There is wide variation seasonally in the extent of the markets. The largest number of sellers throughout the year are concerned with sale of honey and mats. Both these products have a degree of value added through processing and manufacture. Honey is highlighted as important in both markets and this corresponds to the household data which shows honey to be the tree (or forest) product which contributes most, on average, to cash incomes in Tharaka.

Larger items such as beehives, chairs and walking sticks fetch the highest price per item and involve added value. However the volume of sales and the number of vendors is much lower. Overall beehives are the most expensive tree products per item sold in both markets.

In terms of differences between the two markets themselves, Gatunga has similar seasonal profiles for the marketed products but the season does tend to start later by up to one month for walking sticks, bows and some other durable items. This is as would be expected as the markets are not far distant and in similar agro-ecological zones. There are very similar numbers of vendors or tree products in each market, and many vendors go to both markets (they are held weekly on different days of the week). Generally in both markets there appears to be wide variation from week to week and month to month in the volume of sales and prices. There may be a more diversified market at Gatunga catering for local subsistence needs, whereas Marimanti market is more accessible to upland areas so there is a slightly higher volume of sales and slightly higher prices. Consumption items are more prevalent at Gatunga and durables in Marimanti, again perhaps reflecting greater catchment and trade with upland areas in the latter market.

Table 2.3 Marimanti market: overall indicators

	Staples price index (Aug 97=1)	NWTP price Index (Sep 97=1)	Revenue/seller (KSh)	Total revenues (KSh '000)
Sep 97	0.98	1.00	485	15.51
Oct 97	0.99	1.13	453	18.13
Nov 97	0.95	1.11	423	10.38
Dec 97	0.63	0.77	206	4.12
Jan 98	0.64	1.42	269	5.49
Feb 98	1.05	1.14	462	13.87
Mar 98				
Apr 98	0.73	1.11	391	9.42
May 98	0.75	1.31	308	7.89
Jun 98	0.65	0.72	269	5.98
Jul 98	0.69	0.82	298	8.58
Aug 98	0.69	0.90	256	5.18
Sep 98	0.75	0.87	179	3.36
Oct 98	0.62	0.64	163	2.77
Nov 98	0.52	0.75	301	2.81
Dec 98	0.57	0.77	247	3.01
Jan 99	0.67	0.78	216	4.49
Feb 99	0.81	0.66	142	3.24
Mar 99	0.80	0.65	255	3.13
Apr 99	0.63	0.44	97	1.16

Table 2.4 Gatunga market: overall indicators

	Staples price index (Aug 97=1)	NWTP price Index (Apr 98=1)	Revenue/seller (KSh)	Total revenues (KSh '000)
Sep 97	1.01	1.41	720	23.05
Oct 97	1.00	1.07	655	26.22
Nov 97	0.97	1.31	2,316	56.86
Dec 97	0.70	0.85	157	3.13
Jan 98	0.71	0.95	201	4.11
Feb 98	No data due to severe El Niño rains			
Mar 98				
Apr 98	0.75	1.00	356	8.58
May 98	0.66	1.20	360	9.22
Jun 98	0.65	0.79	321	7.14
Jul 98	0.53	0.69	470	13.53
Aug 98	0.37	0.72	360	7.30
Sep 98	0.55	0.65	403	7.55
Oct 98		0.73	219	3.73
Nov 98		0.65	258	2.41
Dec 98	0.57	0.61	220	2.69
Jan 99	0.71	0.74	383	7.94
Feb 99	0.70	0.72	220	5.01
Mar 99	0.77	0.66	267	3.27
Apr 99	0.71	0.78	189	2.27

Figures 2.1 and 2.2 show the variation in staples prices in the two markets and the variation in tree product prices. There appears to be some relation between prices of staples and those of tree products and this may be related to seasonal factors particularly during the onset of rains when access to markets is difficult. However the differences between the maximum and minimum prices for some products shown in Tables 2.1 and 2.2 is masked by the index. This range implies that vendors are prepared to sell cheaply and tend not to carry stock even for durable items. The trade in tree products is petty in nature, with little storage for products and high transport costs.

The final two columns in Tables 2.3 and 2.4 show the revenues per seller and for each market. In terms of revenues to individual sellers, only in one case did this exceed 500 KSh per week (about US$8 or £5). The total revenues for tree products in each of the markets are variable, ranging from less than 3000 KSh to more than 50,000KSh per week.

Figure 2.1 Staple price index

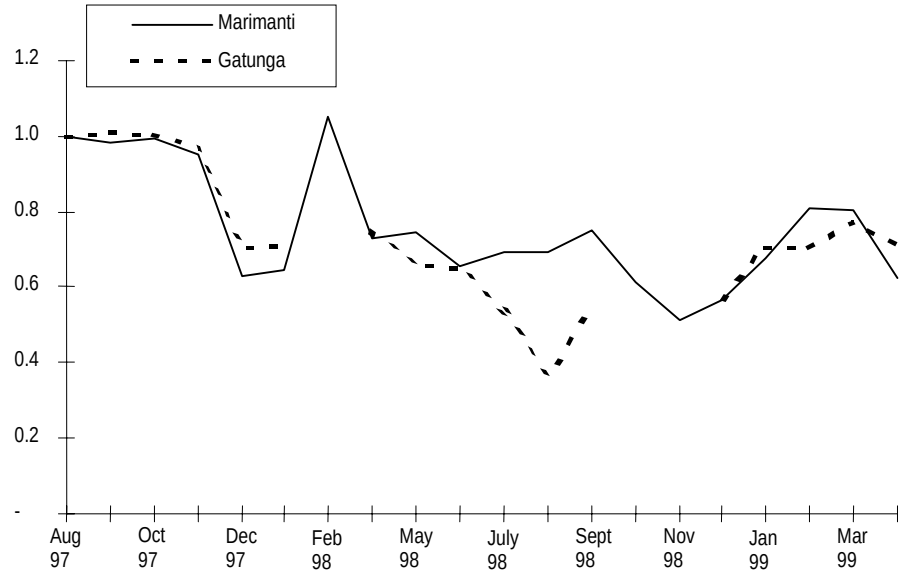
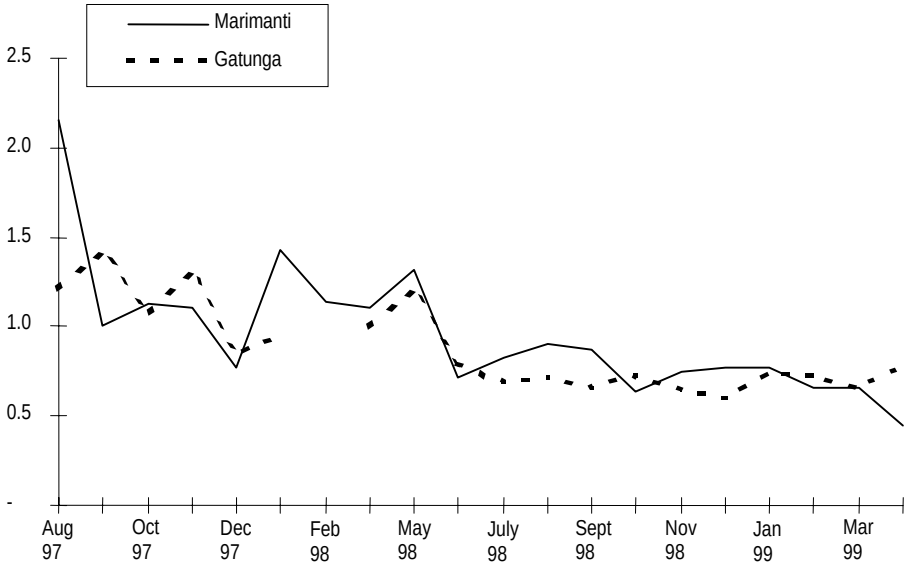


Figure 2.2: Tree Product Price Index



In summary local markets for tree products are poorly developed in Tharaka. The findings confirm those of the household surveys which indicated that, although tree products are important for subsistence, they contribute only a small amount towards cash incomes generally. The products sold in the markets vary between those for direct consumption, and durable goods, some of which require processing or manufacture. However the overall indicators suggest that few traders gain large amounts of income from these activities so we can assume that in all but a few cases these act as supplementary rather than main sources of income for most. Again this is backed up be the household data presented in the previous section.

3. Adding value to tree products

In general, commercial tree use is poorly developed in Tharaka. Where sales of tree products take place, smallholders realise low rates of income from trees partially because there is only a small value added at the household level, the prices they receive are low and markets are undeveloped.

Despite the lack of effective markets, a range of existing indigenous trees uses have market applications, although these are poorly developed. These include fruits (e.g. *Balanites aegyptica*, *Tamarindus indica*, *Adansonia digitata*, *Combretum aculeatum*, etc); gums, oils and resins (e.g. *Acacia senegal*, *Berchemia discolor*, *Hyphaene compressa*); hats, baskets and mats (e.g. *Hyphaene compressa*, *Adansonia digitata*, *Phoenix reclinata*, etc); honey-supporting species (e.g. *Acacia spp.*, *Albizia spp.*, etc): and numerous medicinal trees.

Indigenous trees which are currently used may have a range of additional applications, or existing uses may be further developed – especially in commercial terms. A major challenge is to identify ways in which trees can be used as a source of income by farmers in Tharaka. Through household surveys, community PRA exercises two promising species of indigenous trees were identified for further investigation. This section presents data on the potential of *Melia volkensii* (mukau) as a multi-purpose tree to generate income and on the market for fruit of *Tamarind indica* (muthithi) in Kenya.

3.1 Assessing the potential of *Melia volkensii*

Melia volkensii is already found on farms in Tharaka, and currently contributes to household subsistence, but the species also has significant market potential. An example of the tree on a farm in Tharaka is shown in Plate 3. *Melia volkensii* is a deciduous tree that can attain 6-20 metres in height, occurring mainly in dry bushland and woodland, and in wooded grasslands (Beentje 1994). It occurs from southern Somalia to northern Tanzania and is widespread – both on and off farms – in Tharaka. Major uses of *Melia* include timber, fuelwood, medicines, fodder, bee forage, mulch and green manure. Three of these uses – timber, fodder and carving wood, were further analysed as being potentially important to smallholder livelihoods in Tharaka.

Timber Production

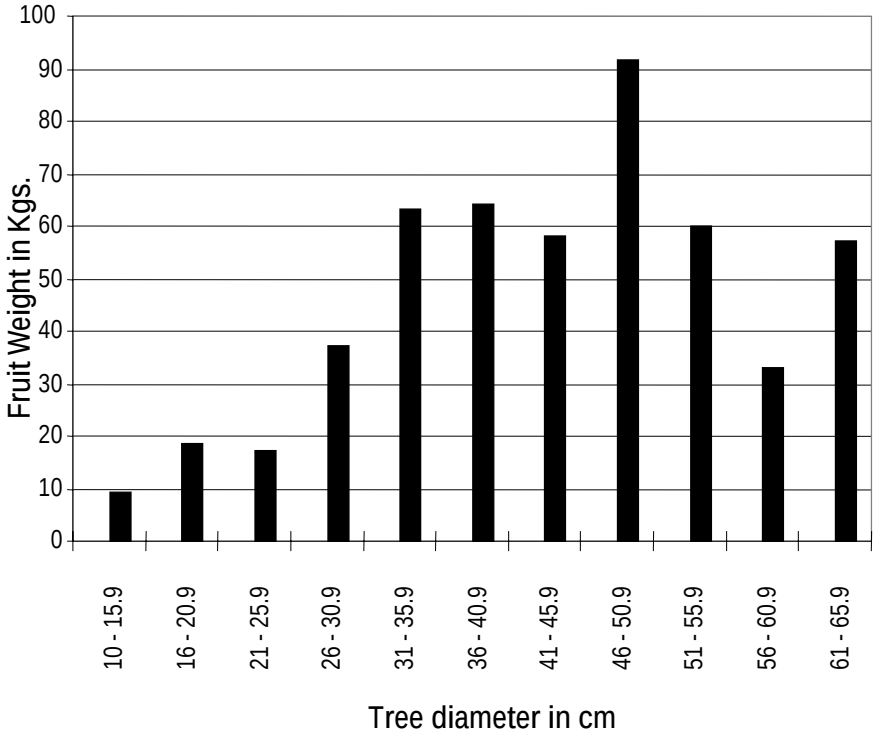
The use of *Melia* for timber production, already taking place to a limited extent, has much potential for further development. *Melia volkensii* is a very fast growing tree, even faster than many of the commercial exotic species (such as *Azadirachta indica* and *Grevillea spp.*) which have been promoted by donors, research institutes and forestry extensionists in arid and semi-arid lands. At an age of ten years the tree has a diameter at breast height (dbh) mean annual increment (MAI) of 2.8 cm, reaching an average diameter of 28 cm. The total volume yield at this age and diameter is over 0.5 m^3 of wood and a merchantable stem volume of 0.22 m^3. From analysis, tree growth picks up at six years, and the rate of increase in MAI starts to decline after ten years. Data from Tharaka (shown in Figure 2 Appendix 6) are comparable to those from other parts of arid and semi-arid Eastern Kenya. At ten years, which is when farmers

in Tharaka tend to fell *Melia*, it is comparable to the maximum point of volume increase. Although *Melia* is not yet well-established in the market, there is a growing demand for its timber. Already dealers from upper parts of Nithi District are coming down to Tharaka, because other sources of timber are becoming progressively more scarce in higher potential areas of the District.

Fodder potential

Many farmers in Tharaka already use *Melia* leaves and fruits as a source of dry-season livestock fodder. *Melia* produces flowers and fruits twice a year, with fruit becoming ripe at the end of the dry seasons as the leaves emerge. Trees can yield up to 100 kg of fruits per year, as shown in Figure 3.1. *Melia volkensii* fodder is perceived to be of high quality for both cattle and goats by Tharakan farmers. The tree comes into leaf, and is pruned for fodder, towards the end of the dry season. This is a time when other sources of fodder are extremely scarce in Tharaka, and when livestock become short of food. *Melia* leaves have a very high protein content (21%) as compared to conventional dairy feeds (an average of 16%) and compares favourably with other fodder species in terms of its crude protein and digestible fibre content (see Figure 4, Appendix 6). Livestock also feed on fallen fruits.

Figure 3.1 *Melia volkensii*: Fruit Production Analysis



Carving wood potential

Tharaka lies close to some of the major carving areas in Kenya, where traditional carving wood species are becoming difficult to access, and expensive to buy. Carvers are already starting to come into Tharaka searching for new sources of raw materials, and *Melia* is being used as an alternative to the most popular species of carving wood. Preference for carving wood is based on many attributes, including durability,

resistance to insects, workability, density and aesthetic value. As described in the Table 3.1, *Melia* has many of these characteristics, and compares well with many of the traditionally popular carving wood species. The sale of *Melia* for carving wood can provide an important market for farmers, and generate significant income.

Table 3.1 Macroscopic features and densities for selected carving wood species in Kenya

	Pores	**Colour**	**Growth rings**	**Grain**	**Texture**	**Rays**	**Density**
Traditionally favoured species:							
Brachylaena Huillensis	NVNE	Grey/yellow	Distinct	Straight	Fine	NVNE	Heavy
Dalbergia Melanoxylon	NVNE	Purple/black	Distinct	Straight	Fine	VHL	Heavy
Olea Europaea	NVNE	Brown/yellow	Distinct	Straight	Fine	VNE	Heavy
Melia Volkensii	**VHL**	**Pink/yellow**	**Distinct**	**Straight**	**Medium**	**VHL**	**Moderate-heavy**
Alternatives:							
Terminalia Brownii	NVNE	Yellow/brown	Distinct	Interlocked	Medium	VHL	Moderate-heavy
Terminalia Pruniodes	VHL	Brown/yellow	Distinct	Interlocked	Medium	VHL	Moderate-heavy

NVNE-Not visible to the naked eye, VNE- Visible to the naked eye, VHL- Visible with hand lens.
Density: Heavy- >0.75g/cm3, Moderate-0.4g/cm3 to 0.74g/cm3, Light-<0.4g/cm3.

Economic analysis of *Melia volkensii* at the farm level

Already used for subsistence purposes, such as fodder, firewood and manure, and with a demonstrable potential for income-generation through such products as timber and carving wood, an important question is whether the further development of *Melia* uses and markets makes financial and economic sense for farmers in Tharaka.

Analysis was made of the costs and benefits of growing *Melia* for farmers, based on existing land uses and market prices in Tharaka. They assume a 10 year rotation of *Melia volkensii* – that which farmers already carry out, and that which is optimal in productivity terms. They take into account both the costs and benefits of production of *Melia* and crops.

Two calculations of the financial desirability of *Melia volkensii* are made; one based on the use of fallow land, and one on integration with crops. For both these analyses it is not possible to quantify the economic contribution of subsistence products of *Melia* such as fodder, bee forage and manure, the environmental impacts such as improved soil fertility, windbreak and crop shelter or the social benefits such as reduced fuelwood and livestock grazing-related labour, improved cash availability, increased livelihood diversity and enhanced security in dry seasons and drought. Thus not all benefits are included in the analysis.

As shown in the Table 3.2, *Melia* competes well as an alternative to crops in purely financial terms. Average returns to cropping (once the costs of labour and other inputs have been deducted, and using local crop mix, yields and price data) are only just under KSh 3,000 or KSh 27,780 over 10 years. Over a 10-year rotation, grown on fallow land, *Melia* can generate cash benefits in excess of KSh 255,000 per acre – nearly ten times as much as this. Taking into account the both opportunity cost of crops foregone and the time factor involved in tree production, this gives a net present value over 10 years, discounted at 10%, of KSh 66,609.

Table 3.2 Returns for *Melia volkensii* per acre of fallow land (KSh/acre)

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Timber income											245,150
Fuelwood income											10,300
Planting labour	-900										
Seedlings purchase	-2,380										
Pruning labour			-260		-345	-797	-964				
Tools purchase		-660									
Loss of crops	-2,778	-2,778	-2,778	-2,778	-2,778	-2,778	-2,778	-2,778	-2,778	-2,778	-2,778
Net income	-6,058	-3,438	-3,038	-2,778	-3,123	-3,575	-3,742	-2,778	-2,778	-2,778	252,672
Net present value	66,609										

It is, however, more likely that farmers will continue to combine crop and tree production as is already the case among the few farmers who do cultivate *Melia*. Here, crops are continued to be grown alongside *Melia* until the fifth year, after which trees have acquired ecological dominance. In effect this means that each field is given five years of fallow; this again fits in well with local farming systems, where land is usually cultivated for 3-4 years and then left to fallow for 5-10 years. In line with average farm sizes in Tharaka (23 acres), cultivated areas (3 acres) and labour availability, and recognising the need to keep at least parts of farms under natural woodland pasture, it is possible for most farmers to put five acres under an integrated production system and plant half an acre with *Melia* every year. This means that at any one time, once the system is up and running (after the tenth year in production), three acres will always be under crops and there will be a continuous stream of income from *Melia*.

Even over the first nine years, before the system is fully established or a continuous flow of tree income is coming in, farmers will receive income from crops of between KSh 6,000 and KSh 12,000 a year. Once the system is established (after the 10^{th} year) the net returns to a five acre combined tree and crop area is more than KSh 128,000 a year or KSh 25,600 per acre (as illustrated in the Table 3.3), comprised of crops for home consumption and for income, and tree income. Over a ten year period the system will yield a positive net present value of some KSh 111,000 or just over KSh 11,000 an acre.

Table 3.3 Potential returns for *Melia volkensii* in five acres of combined trees and crops (KSh/year once system is established)

	KSh/5 acres
Timber income	122,575
Crop income	8,334
Fuelwood income	5,150
Planting labour	450
Seedlings purchase	1,190
Pruning labour	1,183
Tools purchase	66
NET INCOME overall	128,020
NET INCOME per acre	25,604

3.2 Marketing chains for *Tamarindus indica*

The fruit of *Tamarindus indica* (tamarind) was identified as a semi-arid product with significant potential during the course of the research, yet no previous studies had been made on the tamarind trade in Kenya and there is little knowledge of the trade outside of the market actors. A survey was undertaken to investigate the operation of the tamarind market from producer to exporter in Kenya, concentrating on tamarind originating from Tharaka. A rapid reconnaissance survey was used to collect data. Fieldwork primarily took place in Tharaka and Mombasa; comparison visits were also made to Kitui District and Malindi. The fieldwork consisted of tracing the market channels by visiting the markets where tamarind was being sold as well as locating relevant key informants, and all levels of the marketing chain were interviewed (see Appendix 7 for further details).

Domestic demand for tamarind is largely limited to coastal areas, while the majority of tamarind that enters the market is exported to Somalia, Yemen or Zanzibar. There is a severe lack of information on the tamarind market. The consequences within Kenya of this can clearly be seen at the producer level where farmers are currently receiving a very low price for their tamarind. There is considerable potential for developing the market further, possibly through the use of associations and women's groups. Tamarind is found on farms in Tharaka (shown in Plate 4) and is one of the few sources of cash income that is available to farmers between August and September.

Tamarind Characteristics and Uses

The fruits from *Tamarindus indica* are slightly curved, bulged, brown pods. The pods vary in length from around 2-17 cm and in diameter from 2-3.2 cm with 1-12 seeds (Morton, 1999). *T. indica* is native to Ethiopia, Kenya, Madagascar, Sudan and Tanzania and is an exotic in many other countires (Salim et al, 1998). The tree grows in areas with an altitude of 0-1500 m, 350-1500 mm annual rainfall and well drained deep alluvial soils (Salim et al, 1998). In Kenya, the pods are harvested when the skin is brittle and the pulp is red-brown in colour and sticky in texture. One tree will start fruiting from 10-14 years (Morton, 1999) and produce up to 300 Kg of tamarind in a

season (survey respondents). In Tharaka the fruiting season generally runs from July to September/October.

Although there are many uses for tamarind, few are known or practised in Kenya, particularly in inland areas. In Tharaka, the main uses for tamarind are to flavour porridge and provide nectar for honeybees; a couple of individuals made juice but this practice is not widespread. The reason given by respondents in Tharaka for low utilisation of tamarind was that people did not know of alternative uses. In the coastal area, there was more knowledge of tamarind uses where consumers regularly use tamarind to make sauces, porridge, juice, ice and, less often, to tenderise meat. This difference in usage between inland and coastal areas probably explains why there is no domestic market for tamarind in the areas around Tharaka and the relatively high demand for tamarind in the coastal areas such as Mombasa and Malindi. Tamarind has many potential uses which have been described by Morton (1999) including use as snacks, sauces, confectionery, drinks, jam, ice cream, wine, coffee-substitute, pectin, food stabiliser, dye, animal fodder, nectar for honeybees, glue, edible oil and medicine. The pulp is nutritious and is rich in calcium, phosphorus, iron, thiamine, riboflavin and niacin.

When farmers harvest tamarind they pick it from the tree, often using sticks to knock pods down. After harvesting, the farmers (usually women or children) use a heavy stick to beat the tamarind to help break off the skin. The dehusked tamarind is then weighed (most farmers in Tharaka have scales at home) and packed before being carried to the market, generally on the farmer's back or by hired donkey. The tamarind is packed in 50kg bags before transportation from Tharaka and stays in this condition until the tamarind is exported. Very little commercial processing of tamarind takes place in Kenya. The Kenyan Asian community makes a limited use of the tamarind seeds and two businessmen in Meru are known to process tamarind seeds in the following way: seeds are roasted to remove the outer cover, fried, dried and lightly ground, then salt and sugar is added prior to packing.

There are four grades of tamarind:

- Grade 1: dehusked, de-seeded and no fibres
- Grade 2: dehusked, de-seeded with fibres
- Grade 3: dehusked, with seed and fibres
- Grade 4: with husk, seed and fibres.

Most of the tamarind traded is of Grade 3 quality. Grade 2 is also available at times, mostly when a particular order is placed. Tamarind originating from Lamu is normally de-seeded before transportation. When tamarind is de-seeded, the work is carried out on-farm. One person can harvest 100 – 150 Kg in one day and can dehusk 50 Kg in one day. De-seeding takes around 2.5 days for 50 Kg. Grade 4 tamarind is not traded. Dehusked, tamarind with seed stores for up to six months before it is attacked by weevils, whereas de-seeded tamarind can be stored for around 2 years.

Supply

The main areas of tamarind production are in Tharaka, Ukumbani, Pokot, Voi and coastal areas. Seasonality varies from location to location and the main period for shorage is usually March to May. The bulk of the tamarind, including that from

Tharaka and Ukumbani, is marketed between July and September (before the long rains). August to September appears to be a period when some oversupply occurs, although this was difficult to quantify in this survey. Research suggests that the quantity of tamarind that enters the marketing chain is approximately 600-800 tonnes per annum.

Demand and pricing

Demand for tamarind within Tharaka is very low. The price may reflect this, as tamarind Grade 3 retail price is 3 Ksh/Kg (US$0.05). All the tamarind produced for sale in the market is destined for Mombasa. There is a higher local demand at the coast for Grade 3 tamarind and the retail prices which varies from 40-60 Ksh/kg (US$0.66 – US$1) depending on the distance from the main market (Kongowea) in Mombasa.

The price for tamarind fluctuates considerably at the coastal markets during the year. The lowest prices are in times of abundance, which is generally from late July to October/November. The highest prices are up to double the low season prices and are reached when supply is lowest, generally March to May. Although demand is highest during the dry season between January and March and during Ramadan, there is a stable retail demand for tamarind throughout the year.

In general, consumers prefer Grade 2 tamarind (seedless) to Grade 3 tamarind (seeded), but most tamarind that is sold is Grade 3. Grade 2 tamarind commonly sells on the retail market for an additional 20 Ksh/Kg (US$0.33). Farmers in Tharaka do not extract seed unless they cannot sell their tamarind any other way, this occurs when a particular order has been received from the coastal traders. The reason for this is that at the time of the survey (August 1999) the farmers in Tharaka considered that the price for Grade 2 was too low. Farmers were receiving 2 Ksh/Kg (US$0.03) for Grade 3 and 4 Ksh (US$0.07) for Grade 2 tamarind, even though seed extraction takes two and a half times longer than harvesting and dehusking.

Marketing Channels

Farmers sell to rural assemblers who are often, but not always, employed on a commission basis by traders who also act as transporters. These traders are the market actors who deal with the wholesalers, brokers and exporters in Mombasa.

Whilst this survey was being carried out in Tharaka there were cash flow problems. The rural assemblers were waiting to be paid by the traders who had yet to return from a 100t selling trip to Mombasa. Until the rural assemblers received payment, no tamarind would be bought from the farmers. Farmers brought their tamarind to the market but were unable to sell it. There is no local market for the product and the trade is entirely dependent upon the prices that the traders are able to obtain in Mombasa. Thus producers and assemblers are dependent on external factors to successfully market their products; markets are unreliable.

The survey identified five main traders of tamarind in Tharaka. They work in different ways; a few have formed partnerships because of the cost of transportation. Others have a network of contacts or a partnership in Mombasa; these traders are the ones

who are able to access the exporters most easily. One partnership made up of 10 people operates as wholesalers as well as traders and transporters. Traders prefer to sell direct to the exporters, however these actors can be difficult to locate, so traders may instead sell to wholesalers or use a broker to try and access the exporters.

Tamarind from Tharaka is transported by hired truck (from Meru or Chuka) to Mombasa, an 8-10 hour journey. Tharakan traders will store tamarind until there is sufficient to fill at least one 20 or 24t truck. One of the problems mentioned by traders was the lack of credit available for storage and transportation. Credit can be obtained by the rural assemblers employed by the traders, but is not extended to farmers. This could perhaps change if farmer associations were formed. Occasionally a farmer is able to sell a tree's production at the beginning of the season, but farmers reported that the returns were considerably below market value.

Figure 3.2 shows the marketing channels for tamarind as well as Net Marketing Margins (NMM) and Profit Margin as a Percentage of Capital (PM). The percentages of NMM are shown above the arrows and PM shaded below the arrows. The consumer price used was from Mombassa. Appendix 7 outlines the calculation of these margins. The calculations showed the PM for rural assemblers (17%), traders (20%), wholesalers (45%) and retailers (34%). Using the Total Gross Marketing Margin (TGMM = [Consumer price - Farmers price/Consumer price] X 100) the farmers participation percentage of the Gross Marketing Margin (GMMp) was found to be 5%.

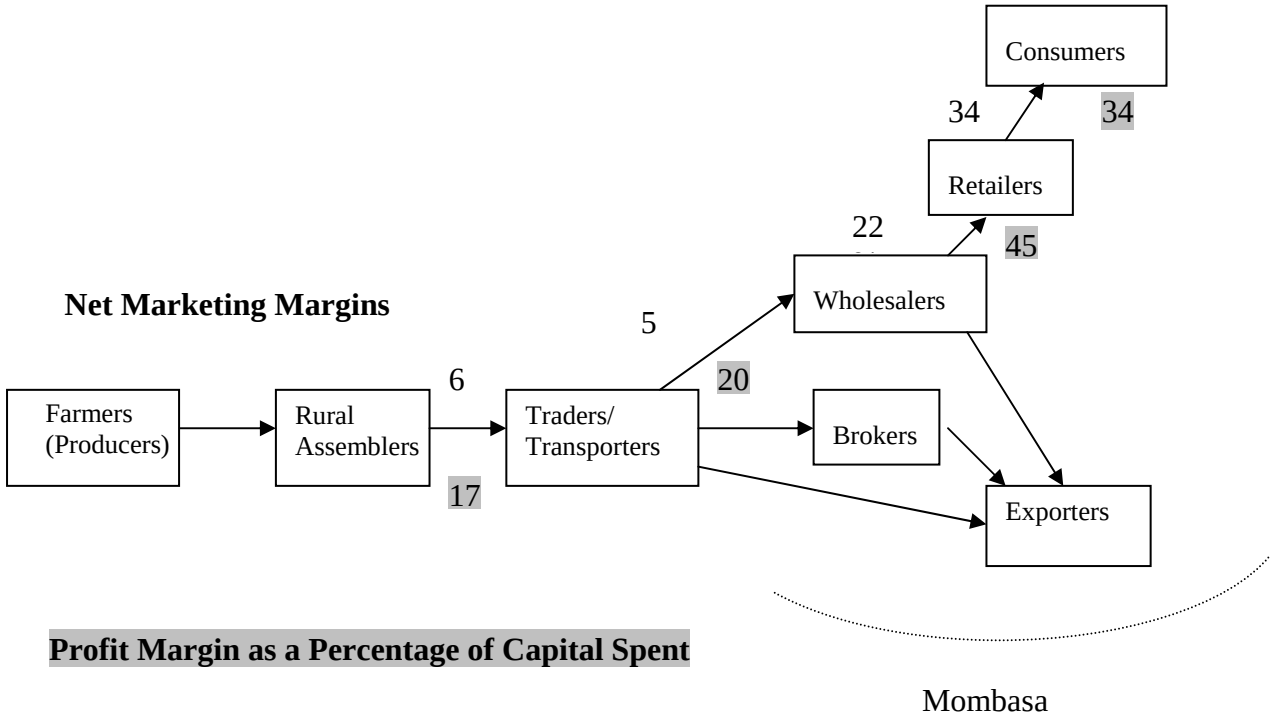


Figure 3.2: **Tamarind Marketing Channels**

Comparing the above calculations, it is evident that although the traders have an NMM of only 5%, the PM they receive is comparatively high (23%). The wholesalers achieve the highest PM (45%), which perhaps in part shows that the barriers to entry at this level are quite high. Wholesalers need to have good contacts in the production area and must have storage facilities at Kongowea market in Mombasa. Regarding trade from Tharaka and West Pokot, traders and wholesalers tend to deal mainly with production from the location that they originate from. As far as the retailers are concerned, the barriers to entry are much lower. These retailers are generally located in fruit markets in Mombasa and along the coast. The two levels in the domestic marketing chain, which deal with tamarind in bulk are the traders and the wholesalers. The retailers generally sell tamarind along with other products. As the tamarind is not processed after leaving the farmer, the GMMp of 5% is more reflective of the amount received by the farmer than is the case when researching marketing margins of products which are processed in part of the marketing chain. NMM and PM were not calculated for the farmers as this is the most labour intensive part of the trade, so the figures could not be compared on the same basis as the rest of the marketing channel.

It was not possible to calculate the Marketing Margins for exporters or brokers because the consumer price at the end of that marketing channel was not ascertained as part of this survey. The prices achieved by traders if they sold directly to exporters varied, but they frequently received 50% higher prices and sometimes more than if they sold to wholesalers. Although the domestic trade NMM and PM are given above, it should be noted that the PM and NMM would be much higher for traders selling to exporters, as very few additional costs are involved.

Tamarind Exports and the World Market

Tamarind has been exported from Kenya since the 1980s and possibly since the 1950s, although there is little secondary information available on this commodity. HCDA (Horticultural Crops Development Authority) in Kenya do not collect tamarind export information. Kenyan Customs and Excise records reveal that approximately 120 tonnes of tamarind were exported from Mombasa during August 1999. Tamarind is exported for approximately 9 months of the year. If demand is stable, then the quantity of tamarind exported in one year is estimated to be in the region of 1000 tonnes. Export records and exporters showed that the destinations for tamarind exports from Kenya are primarily Somalia and Yemen. Tamarind is also exported to Zanzibar and from there to Dubai. Other regions that import tamarind and could be potential markets for Kenyan tamarind include Japan, North America, Europe and Middle East.

Lack of information is a serious problem throughout the tamarind marketing chain. Traders mentioned that they find it difficult to locate exporters (particularly those traders who do not have coastal partnerships or networks). There is at present no association of exporters and no one location where they may be found. Exporters also suffer from a lack of information, as they would like to know more about prices and requirements of tamarind in their existing and potential markets. Lack of information also acts a barrier to entry into the tamarind market: it was noticeable that many of the respondents in the survey had been in the tamarind trade for many years.

5. Summary of findings

This project has investigated different aspects of the use, values and potential of tree products to smallholders in a semi-arid region of Africa, Tharaka in Kenya. It uniquely provides a view of household use, markets and non-market values, and marketing chain analysis to give a comprehensive picture of the opportunities and constraints for adding value to tree products. It is the first use of hybrid and complementary methods to assess these issues.

Household surveys and community PRA demonstrated that tree products are valuable to farmers in this region of Kenya primarily for their subsistence values. Households in Tharaka also value forest reserves for a number of non-material uses, and there are traditions of cultural values and heritage associated with trees and forests. Such values are often overlooked in conventional analysis of income and livelihoods.

Market surveys show that household income is generated through the local sales of a variety of tree products, the most important being honey and furniture. But few people make more than supplementary income from sale of tree products and the production of value-added tree products to supply these markets is not well developed. Vendors tend to sell their stocks at each market day because transport costs are high, the markets are isolated and storage is a constraint to expansion.

The household and market surveys thus both demonstrate that subsistence uses of tree products are most important in this ASAL area and that markets for tree products are poorly developed. However, there are some trees and tree products which can successfully be combined with existing practices and farming systems which could add value and generate income for farming households.

Melia volkensii is a multi-purpose tree which can be used as part of a fallow farming system. It provides useful products for subsistence use – fodder, timber, and also products for sale – timber, carving wood. The species is indigenous to Tharaka and has been found to be highly productive in the conditions there, much more so than exotic species introduced through forestry and agriculture extension programmes. The tree has a number of potential advantages; it is adapted to the local conditions, fits with farming system, provides subsistence and cash products and at critical times of the year. It is already grown on farms and some farmers are experimenting and investing in planting *Melia* on farms.

The fruits of *Tamarindus indica* have regional markets in Kenya and are also exported from Kenya. Once again tamarind is indigenous to Tharaka and grows well in the semi-arid conditions. The fruit are harvested and sold towards the end of the dry season when few other sources of cash exist. Marketing networks already exist, but farmers have very poor access to information or to support in terms of credit or transport, which makes them powerless in choosing when and how to market tamarind fruits. Opportunities exist to expand the sale of tamarind from Tharaka given support to producers and this potentially could benefit poorer farmers and perhaps women's groups. However, lack of credit and technical and market information about trees is a major constraint to farmers wishing to expand their income and production base.

The implications of these findings are discussed in subsequent sections of this report.

Dissemination

Publications

Emerton, L., Mogaka, H. and K.Brown (1998) Policy Incentives for Community Forest Conservation in Kenya: A Review of Current and Proposed Legal Framework African Centre for Technology Stiudies, BioPolicy paper, in press.

Brown, K. and L. Emerton (1998) Where there are no markets: Adding to non-wood tree product values in dryland Kenya. In P.Mushove, M.Mubaiwa, M.Mukwekwerere and C.Pfukwa (eds.) *Forestry in a Changing Political Environment: Challenges for the 21st Century*. Proceedings of the 15th Commonwealth Forestry Conference, Forestry Commission, Zimbabwe pp 166-171.

Mogaka, H. (1999) Human economic values of environmental and natural resources: The case of Ntugi and Kijege forest reserves in Tharaka District, Kenya. ODG Research Working Paper, Overseas Development Group, University of East Anglia, pp36.

Maina, A.M. (1999) Market-based economic incentives for natural woodland conservation in Tharaka, Kenya, in Emerton, L. (ed) Economic Incentives for Biodiversity Conservation in Eastern Africa: Proceedings of a Workshop held 11-19 March 1999 in Nairobi, Kenya, IUCN Eastern Africa Regional Office, 60 pp.

Conference and workshop presentations

Brown, K. and L.Emerton, (1997) Where there are no markets: Non-timber forest values in Dryland Kenya. Paper presented at Fifteenth Commonwealth Forestry Conference: Zimbabwe, May 1997.

Maina, A.M. (1999) Market-based economic incentives for natural woodland conservation in Tharaka, Kenya, Economic Incentives for Biodiversity Conservation in Eastern Africa, Workshop held 11-19 March 1999 in Nairobi, Kenya.

Brown, K. (1996) Enhancing the role of NWTPs in smallholder livelihoods in smei-arid Kenya: A Research Agenda Research Seminar, African Centre for Technology Studies, Nairobi, Kenya, December 1996.

Emerton, L. (1997) Participatory Environmental Valuation of Forest Products in Kenya, Workshop on Domestic Potential of NTFP, Yaounde Cameroon, January 1997.

Betser, E. (1999) Markets for Tamarind in Kenya, ICRAF Research seminar, ICRAF Nairobi, August 1999.

Brown, K. (1999) Trees and tree products in rural livelihoods in semi-arid Kenya Natural Resources Research Group Seminar, University of East Anglia, November 1999

Internal reports and discussion papers

Emerton, L. et al. (1997) Tree product use and value in Tharakan Livelihoods, Background report complied by PRG, Kenya, December 1997

Brown, K. (1997) A Review of Literature on Conceptual and Contextual Issues: Evaluating the role of NWTPs in smallholder livelihoods in semi-arid Kenya, University of East Anglia, UK, November 1997.

Betser, E. (1999) Market Survey of Tamarind in Kenya, ICRAF, Nairobi, Kenya, August 1999.

Contact with target and other institutions

In addition to our direct project collaboration there has been active engagement and discussion and visits with the following institutions throughout the period of this research project:

- ICRAF Tree Domestication Programme
- African Centre for Technology Studies, Nairobi
- Kenya Forestry Research Institute, Nairobi, Kenya
- Moi University Forestry Department, Eldoret, Kenya
- IUCN Eastern Africa Regional Office, Economics of Biodiversity Programme
- Overseas Development Institute, London, Workshop on Valuation of Participatory Forest Projects, April 1998
- International Institute for Environment and Development, Environmental Economics and Hidden Harvest Programmes
- CIFOR (Centre for International Forestry Research) research programmes

Plans for further dissemination

Currently three activities are planned for further dissemination of project outputs:

1. Publication of research findings as a booklet by RELMA (SIDA/ICRAF Regional Land Management Unit for Eastern and Southern Africa) (provisionally entitled 'Economic aspects of natural woodland management in Tharaka'). This organisation has an excellent publication series and a wide distribution list, which goes to our target audience - forest/land management decision-makers and policy-makers throughout the region.

2. Further workshops in Kenya, yet to be confirmed, possibly in collaboration with IUCN Regional Office in Kenya.

3. Three papers on different aspects of the research for publication in scientific journal are planned and in various stages of drafting.

Contribution of Outputs

In addition to providing a wealth of empirical data on the role and values of tree products in Tharakan smallholder livelihoods the findings of this research project make a significant contribution to knowledge and understanding in three key areas of natural resources and development studies. These are: the role of trees and tree products in rural livelihoods; the opportunities for incentives for smallholder farmers to invest in trees and thus conserve forest biodiversity in semi-arid regions; the development of methodologies which combine economic valuation within the framework of people's own perceptions and livelihoods.

1. Role of Tree Products in Rural Livelihoods

This report opened with the statement that rural livelihoods are vulnerable in semi arid Kenya. This vulnerability was underlined to the research team during the course of our study. In the first year, Tharaka experienced severe drought, and in the following year torrential rains and widespread floods generally thought to be caused by the El Niño phenomenon. As a result communications and access were cut off for weeks at a time, and a cholera outbreak reached epidemic proportions. Under such conditions and where cropping has limitations and high risks (see Appendix 2) smallholders have diversified livelihood strategies. However at the same time opportunities for income generation are severely constrained with access to markets limited. The research findings show that trees and tree products play a number of roles. These mainly involve subsistence and inputs to farming systems. For a relatively small number of people, tree products provide cash income.

Our research therefore contributes to debates on sustainable rural livelihoods (although it was initiated before the term became widely used, see Carney 1998). It is particularly informative in identifying the role of tree products – as perceived and defined by smallholders themselves – in a semi arid region. Much of the previous research on tree products has focused on the humid tropics and on forest zones. For example Byron and Arnold (1999) devise a useful framework for assessing dependence on forests and forests products, but fewer studies focus on the drylands. This research provides insights into tree products in a specific environmental context and from both on-farm trees and trees in dryland forests. The findings therefore inform understanding of livelihood diversification (Ellis, 1998) in the survival strategies of smallholders in dryland areas of Africa (Mortimore, 1998; Scoones et al., 1996). The findings suggest that tree products provide more than food security even in such a food-deficit and risk-prone context as Tharaka (e.g. Ogle, 1996).

In highlighting the potential of tree products as income sources we must also be wary that dependence on particular products may not enhance the sustainability or security of livelihoods. For example, Arnold and Townson (1999) remind us, forest goods are often inferior goods that fall out of consumption patterns as consumer incomes rise. An example in Tharaka would be mats which may well be displaced in both rural and urban markets by more convenient factory-made substitutes. Therefore the impacts of market factors on the potential for growth varies for different products.

The findings show than in some cases tree products collection and marketing are activities of last resort. People engage in these activities when no other sources of

income are available (Arnold and Townson, 1999). Many of these activities involve fairly simple gathering, petty trading and basic processing – in other words, little opportunity for value-added. The advantage with these tree product activities is that there is relative ease of entry and low capital and skill thresholds. But, as we see in Tharaka, these activities provide only small amounts of cash. More viable and sustainable activities generally require greater capital and skills, and may depend on large urban markets for products (Arnold and Townson, 1999). The key here is to produce products which compete with modern-sector alternatives and which have positive elasticities with increasing incomes, or which have some cultural significance where they are able to maintain a market share because there is no modern sector equivalents. The opportunities for these products might be some items of furniture, carving wood or some traditional medicines. However current production and processing need to be enhanced in order for these products to provide sustained income.

The study also highlights changing attitudes toward tree products and woodlands. Younger people view trees as a means of generating income, and put less emphasis on the cultural and non-material values associated with trees. This has implications for conservation of remaining woodlands and the ways in which trees may be incorporated into current systems of fallow farming (Schrekenberg, 1999 provides evidence from West Africa suggesting that declining fallows threaten the continued existence of trees in the landscape). It is therefore important to identify as our research has, useful tree species which are compatible with existing farming practices but which allow income generation and a degree of intensification of land use within them.

Our findings suggest, however, that the extent to which tree products can enhance livelihoods – rather than ameliorating risk and providing sustenance, livestock feed or small amounts of cash in times of contingency – depends on strengthening institutions, markets and communications. Hyman (1996: 213-214) suggests a range of possible interventions to improve collection, procession and marketing potential for forest products. Currently none of these are being implemented in Tharaka; there is no support available to smallholder to enhance the role of tree products in livelihoods.

2. Incentives for conservation and sustainable management of trees and forest biodiversity

The research findings inform debates on what factors enable farmers to invest in trees on farms and also their attitudes towards off-farm trees and woodlands. It demonstrates some of the constraints to replication of the ‘More People, Less Erosion’ story reported in Machakos District, which has very similar agro-ecological conditions as Tharaka (Tiffen et al. 1994). In Machakos smallholder farmers enriched their environment by extensive tree planting on farms, part of a process of intensification of land use and production, in part because they had access to markets, information and capital to invest. In Tharaka, not so far away from Machakos in geographical terms, farmers have poor access to each of these important factors. Farmers in Machakos also have secure land tenure, another development yet to become widespread in Tharaka.

Despite this, farmers are making use of trees on their farms and they are planting trees (Brown, 1990) as well as conserving existing trees. Our research also shows that farmers value off-farm tree resources for more than their direct sues in subsistence and income generation (see Castro's study (1995) of areas closer to Mount Kenya for the importance of cultural and social values of forests). Our research finds that given greater information, market opportunities, and technical advice and perhaps credit, and with appropriate collective action, trees and tree products could make a more significant contribution to farmers livelihoods. In many respects the incentives needed are similar to those discussed by other authors, such as Arnold and Dewees (1997) although in Tharaka some very basis infrastructure and resources – good reliable communications for example – are not present.

Another key area which this research informs is the extent to which the policy and legislative framework in Kenya is able to support smallholders' use of trees and to provide the necessary incentives. Our analysis of the policy framework in Kenya suggests that the new legislation currently being introduced has some scope to encourage the conservation of trees and forest, by facilitating a greater flow of benefits to farmers. For example the rights to access, use and benefits of trees and forest and the designation of community forests is included in the new Forest Act. However unless a pro-active approach is taken to implementing policy there is a danger that the legislative framework will represent empty rhetoric and be seen only to pay lipservice to the participation of stakeholders in sustainable forest management and conservation. Although the policy and legislative framework represents a significant recognition of the rights of different stakeholder, much needs to be done to translate it into concrete action. The findings of this research highlight some of the priority areas for action, particularly with regard to strengthening markets for tree products.

3. Participatory valuation and environmental economics methodology

This research also makes a significant contribution in terms of the methodological approaches and techniques it has developed. Participatory research techniques, including PRA or Participatory Rural Appraisal, have now become commonplace in development practice and increasingly as part of the tools employed by researchers. Often they are seen as alternatives to conventional economic and social research techniques such household surveys and cost benefit analysis. Participatory techniques are often promoted as being cost-effective, culturally appropriate and adaptable, and yield greater insights into local people's perceptions. Participatory techniques have been usefully employed in forestry for, for example, inventory and mapping (Carter, 1996). If competently used they may give voice to local views, priorities and concerns and thus contribute to the empowerment of local communities. However, participatory techniques are commonly criticised as yielding subjective, non-representative and non-generalisable, qualitative information. More critical discussion highlight the biases probably in the information collected using participatory techniques and the danger of further amplifying socially constructed testimonies and views (Goebel, 1999).

The research sought to use a variety of techniques, including conventional survey techniques, with Rapid Rural Appraisal and Participatory approaches to generate data which was both qualitative and quantitative and which reflected Tharakan smallholder

farmers' priorities and values. The methodology adopted therefore built on the pioneering work of the research team on Participatory Environmental Valuation (Emerton, 1996; Emerton and Mogaka, 1996; FitzGibbon et al. 1995) and used Contingent and Pair-wise Ranking and other participatory techniques to investigate values and uses of tree products. In combining these approaches it sought to overcome the short-comings of using single approaches and also to triangulate and verify data yielded from different methods (see Davies et al. 1999 for comparison of participatory and conventional economic research techniques). This approach has generated reliable quantitative and qualitative information of tree products and uses and has successfully engaged with farmers and communities in Tharaka. Such hybrid techniques adapted to different cultural and environmental contexts are recommended for the study of development and natural resource management issues such as the focus of this research. The Value of Trees project in Zimbabwe (Adamowicz et al, 1997; Ayling et al., 1997) has shown that combining techniques – in their case continent valuation, observed behaviour and derived demand techniques – can provide insights into a wide range of goods and services of trees, and also help to build a dynamic understanding of changing uses. Our study undoubtedly adds to the growing body of work that validates the use of hybrid research methods.

Relevance of findings to DFID and target institutions

The relevance of the research findings are discussed with respect to three different aspects; research, policy and development practice.

1. Research

- The research findings point to some important implications for sustainable rural livelihoods in subsistence based economies. The critical importance of trees for subsistence is highlighted, but also the non-use values associated with tree resources. It is also relevant to research on trees on farms and to understanding of processes of land use and agricultural intensification. It therefore has relevance to research in research institutions such as ICRAF and CIFOR, and to the Sustainable Rural Livelihoods focus in DFID.

- The study of tamarind fills a gap in knowledge on the marketing chain for this product. These findings will be useful to various institutions within Kenya (including KEFRI) and also to research in ICRAF where markets for tree products have been identified as an area where relatively little research has so far been undertaken.

- The methodological advances this research has made and the techniques it has adopted, including the mixture of techniques used will inform research into forest management, uses and values of forest and tree resources and other natural resources, so is of use to many research and education institutions. In particular the use of PEV techniques triangulated with other methods may be an approach which can be widely adopted by target institutions such as KEFRI and ICRAF.

2. Policy

- The study highlights the need for a continuing focus on the semi-arid regions of sub-Saharan Africa. These regions continue to be marginalised and disadvantaged, and are home to a significant share of the most impoverished people in Africa. This is especially relevant to the DFID programme to Kenya where emphasis has shifted away from the ASAL to HMPL in recent years. In addition the Government of Kenya and other bi-lateral programmes and multi-lateral agencies could use the findings from this research to underline the importance of continuing support and policy development and implementation in ASAL.

- The research findings highlight the opportunities and constraints within the new legislative and policy framework in Kenya. It is not enough to enact new laws and policies; pro-active and innovative implementation and resources are necessary of legislation is to be successful in meeting the aims and objectives of more sustainable forest management and greater flow of benefits to local resource users.

3. Development practice

- The research has highlighted the importance of enhanced flows of information to resource users in order to benefit from tree products. This has useful lessons for government and NGOs working in the field in Kenya at a time when extension and advisory services have been cut back to rural areas.

- The research has highlighted the need for credit to support smallholders in order to successfully market tree products. As in the case of tamarind, credit is available to traders but not to rural producers, who are therefore severely disadvantaged. This is especially relevant to NGOs, Banks, Credit organisations, Farmers and Producers Unions and government agencies.

- The findings demonstrate that social capital is critical to the development of marketing networks. Support to farmers' groups, women's groups, marketing collectives could be an effective way of enhancing the income generating opportunities from tree products for smallholders.

- Indigenous trees may provide multiple benefits to smallholders and are often adapted to the harsh and uncertain conditions of the ASAL. More research into their characteristics and opportunities are necessary and they should be the focus of local nursery and extension work. Such work should be strengthened under the auspices of Kenyan research institutes, such as KEFRI.

Follow up action and further research

This research has covered a number of different aspects of tree use, values, markets and potential. There are many areas which could be further researched and studied. A few are indicated above. The two critical areas where further work should be prioritised are the provision of information and credit to smallholder farmers, and the further investigation into existing and potential markets for tree products from the ASAL.

References

Adamowicz, W., M.Luckert, M.Veeman (1997) *Issues in using Valuation Techniques Cross-culturally: Three cases in Zimbabwe using Contingent Valuation, Observed Behaviour and Derived Demand Techniques.* Fifteenth Commonwealth Forestry Conference: Zimbabwe, May 1997

Adger, W.N., Brown, K., Cervigni, R. and D.Moran (1995). Total Economic Value of Forests in Mexico. *Ambio* **24**.5: 286-296.

Arnold, J. E. M. and P. A. Dewees, Eds. (1997). *Farms, Trees and Farmers*. London, Earthscan

Arnold, M and I.Townson (1999) *Potentials and Limitations of Non-timber Forest Product Activities to Contribute to Conservation and Rural Development: Recent Evidence from Africa*. Oxford Conference on African Environments: Past and Present, University of Oxford, July 1999.

Ayling, R. et al. (1997) *Valuing the Woodland Resources of Savanna Regions: A Conceptual Model of Woodland Use and Change*. Fifteenth Commonwealth Forestry Conference: Zimbabwe, May 1997.

Barrow, E. G. C. (1996*). The Drylands of Africa: Local participation in Tree Management*. Initiatives Publishers, Nairobi.

Blomley, T. et al. (1991a) *Use and Management of Indigenous Trees and Plants by the People of Tharaka, Meru* Bellerive Foundation, Nairobi, Kenya

Blomley, T. et al. (1991b) *Land and Tree Management in Tharaka, Meru* Bellerive Foundation, Nairobi, Kenya

Brown, K. (1990*). Women's Farming Groups in a Semi-arid Area of Kenya: A Case Study of Tharaka Division, Meru District*, PhD thesis, University of Nottingham.

Brown, K. (1994) Approaches to Valuing Plant Medicines: The Economics of Culture or the Culture of Economics? *Biodiversity and Conservation* **3**.8: 734-750.

Byron, N. and M.Arnold (1999) What Futures for the People of the Tropical Forest? *World Development* 27.5, 789-806.

Carney, D. (ed) (1998*) Sustainable Rural Livelihoods: What Contribution can we Make?* Department for International Development, London.

Carter, J. (1996) *Recent Approaches to Participatory Forest Resource Assessment* Rural Development Forestry Study Guide 2, Overseas Development Institute, London.

Castro, A. P. (1995). *Facing Kirinyaga: A Social History of Forest Commons in Southern Mount Kenya* Intermediate Technology Publications, London.

Davies, J., Richards, M. and W.Cavendish (1999) *Beyond the Limits of PRA? A Comparison of Participatory and Conventional Economic Research Methods in the*

Analysis of Ilala Palm Use in South-Eastern Zimbabwe, Overseas Development Institute, London, May 1999.

Ellis, F. (1998) Household strategies and rural livelihood diversification. *Journal of Development Studies*, 35.1: 1-38.

Emerton, L. (1996) *Valuing the Environment: Case Studies from Kenya.* African Wildlife Foundation (AWF), Kenya.

Emerton, L. and H. Mogaka, H. (1996) Participatory Environmental Valuation of Forests Resources in the Aberdares, Kenya. In *Participatory Learning Action Notes Number 26.* International Institute for Environment and Development, June pp1-10.

FitzGibbon, C. D., Mogaka, H. and J.Fanshawe (1995) Subsistence Hunting in Arabuk-Sokoke Forest, Kenya and its Effects on Mammal Populations *Conservation Biology*, 9.5:1116-1126.

Goebel, A. (1999) Process, participation and power: Notes from 'participatory' research in a Zimbabwean resettlement area *Development and Change* 29: 277-305.

Hyman, E.L. (1996) Technology and the Organisation of Production, Processing and Marketing of Non-Timber Forest Products in Ruiz Perez, M. and J.E.M.Arnold (eds) *Current Issues in Non-timber Forest Product Research*, CIFOR, pp197-218.

Kumari, K. (1995) Mainstreaming biodiversity conservation in Peninsular Malaysia. *International Journal of Sustainable Development and World Ecology*, 2:182-198.

Mortimore, M. (1998) *Roots in the African Dust: Sustaining the Drylands*, Cambridge University Press, Cambridge.

Morton, J. (1999) Tamarind. In: *Fruits of Warm Climates* p115-121. Miami, Florida. Website: http://www..hort.purdue.edu/newcrop/morton/tamarind.html

Ogle, B. (1996) People's Dependence on Forests for Food Security, in Ruiz Perez, M. and J.E.M.Arnold (eds) *Current Issues in Non-timber Forest Product Research*, CIFOR, pp219-242.

Salim et al (1998) *Agroforestree Database, A tree species reference and selection guide*. ICRAF, Nairobi.

Schreckenberg, K. (1999) Products of a managed Landscape: Non-timber Forest products in the Parklands of Bassila Region, Benin *Global Ecology and Biogeography* 8, 279-289.

Scoones, I. et al (19996*) Hazards and Opportunities: Farming Livelihoods in Dryland Africa*, Zed Press and IIED, London.

Tiffen, M., Mortimore, M. and F.Gichuki (1994). *More People, Less Erosion. Environmental Recovery in Kenya*. John Wiley, Chichester.