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## **ECONOMICS OF HARVESTING AND MARKETING SELECTED INDIGENOUS FRUITS IN MWINGI DISTRICT, KENYA**

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# 107- ECONOMICS OF HARVESTING AND MARKETING SELECTED INDIGENOUS FRUITS IN MWINGI DISTRICT, KENYA

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## **Abstract**

Constant droughts especially in the Arid and Semi-Arid Lands (ASAL) have led to recurrent crop failures and livestock losses. Households have therefore resorted to other alternatives which can provide both food and income. Trade in indigenous fruits contributes to livelihoods through income generation and as a safety net for consumption and income smoothing. This paper presents the analysis of economic returns from harvesting and marketing indigenous fruits and the socio economic factors that influence participation in trade of indigenous fruits. The results are based on a survey conducted in Nuu division, Mwingi District, where 120 randomly selected households were interviewed using a pre-tested semi-structured questionnaire. Logistic regression model, Gross Margin Analysis, and Benefit cost ratios were used during the analysis. Data was processed and analyzed using SPSS20. The Gross margins depicted harvesting of indigenous fruits for trade as a profitable venture. High benefit cost ratios of greater than 3.0 were reported in all the three fruits under study. Higher returns to labour and other associated costs were notably reported in the distant market as compared to the local market. The analysis of socioeconomic factors influencing participation in indigenous fruits' trade identified household size, gender, form of employment and market distance to be significant variables. Respectively, market distance and household size negatively and positively influenced participation in harvesting indigenous fruits for trade. The female headed households and low income earners were more likely to participate in trade of indigenous fruits.

Key words: Indigenous fruits, gross margins, Logit, Benefit Cost Ratios (BCR), Returns to Labour

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## 1. Introduction

Poverty which is closely linked to food insecurity remains a deterrent to the survival of many not only in Kenya but also in other Sub-Saharan countries. This is mainly due to the recurrent crop failures and livestock losses as a result of drought (GoK, 2008). A worrying characteristic of the changing pattern in the study area (Mwingi District), is that rains come when least expected and farmers cannot plan their farm operations. Results from the 2010 short rains assessments indicated that households in Mwingi District were unlikely to sufficiently meet their food needs even though there was a decline in cereal prices. This was due to the low purchasing capacities after experiencing nearly five poor or failed seasons in succession (FEWSNET, 2010).

During periods of drought, households employ other alternatives to provide them with food and the much needed income. Indigenous fruits are essential to the livelihoods of most rural communities in the dry lands and reliance upon them as a source of food and household income is not a new phenomenon in Kenya (Maundu *et al.*, 1999; Muok *et al.*, 2001). Notably, indigenous fruits contribute to food security of the rural population by providing a vast array of food which supplies essential nutrients especially at times when other food sources are unavailable (Mithöfer *et al.*, 2003). The fruits act as an important source of vital nutrients and essential vitamins especially to the growing children who are prone to malnutrition. Baobab fruits, for example, provide six times vitamin C compared to an orange and have calcium level higher than that of a cow's milk (Ondachi, 2001).

Not only do indigenous fruits provide food for household consumption during the dry seasons, but they also act as a source of income for the households. Trade in indigenous fruits contribute to livelihoods through income generation and as a safety net for consumption and income smoothing (Angelsen and Wunder, 2003; Belcher *et al.*, 2005; McSweeney, 2005). Greater proportions of poor households engage in commercialization of indigenous fruits than do wealthy households, and it represents a greater fraction of their total livelihood. Typically, the poor households have low skills, education and limited employment opportunities. They have limited abilities to negotiate with buyers and are price-takers (Shackleton *et al.*, 2002). Some households see trade in indigenous fruits as only a temporary activity whilst they seek or hope for permanent formal employment. Others trade in non-timber forest products as their primary livelihood activity, in which they take pride in being self-employed.

In the varied commercialization aspects, some studies have shed light on how proceeds from the sale of indigenous fruits help in poverty alleviation (Poulton *et al.*, 2001; Leakey, 2005; Ndoye *et al.*, 2006). Although poor households may sell Non Timber Forest Products during times of need, middle to upper income households with access to capital, transport, markets and with alternative fallback options, can earn more from commercialization as a primary livelihood activity (Kepe, 2002; Ambrose-Oji, 2003; Angelsen and Wunder, 2003). Fisher, (2004) suggests that incomes derived from NTFPs contribute towards reducing inter-household inequality more so than other income sources including waged labor, self-employment and cash transfers. From the above, it is

clear that patterns of use and trade in Non-Timber Forest Products in relation to household wealth are variable across different studies.

The widely traded indigenous fruits in Kenya are tamarind (*Tamarindus indica*) and baobab (*Adansonia digitata*) (Maundu *et al.*, 1999; Muok *et al.*, 2001). Maundu *et al.*, (1999) still observed that chocolate berry (*Vitex doniana*) was sold in local market centers within the Eastern province of Kenya. Market studies that have been carried out in Kenya indicate that a number of indigenous fruits are sold in the local markets and major urban centers like Mombasa (Maundu *et al.*, 1999; Muok *et al.*, 2001). Muok *et al.*, (2001) noted that only a few indigenous fruits were being processed on limited scale to produce commercial products. The tamarind is also exported to Tanzania, Zanzibar and the Middle East (Muok *et al.*, 2001).

Based on the literature reviewed, for instance, Maundu *et al.*, (1999) and Muok *et al.*, (2001), this study selected the three indigenous fruits majorly traded in the study area: tamarind (*Tamarindus indica*), baobab (*Adansonia digitata*) and chocolate berry (*Vitex doniana*).

In this paper, we examine the activities and costs associated with harvesting indigenous fruits for purposes of trade and the economic returns from such engagements. We explore the level of market participation and the challenges faced by traders in the sale of indigenous fruits. Analysis of the socio economic factors that influence the decision of households to participate in harvesting indigenous fruits for sale is an integral part of this paper.

## **2. Materials and Methods**

### *2.1 Site description*

The study was conducted in Nuu division in Mwingi District located at a latitude of -0.9333, longitude of 38.0667 and an altitude of 940 meters. Mwingi District is one of the Arid and Semi-Arid Lands (ASAL) in Kenya and is located in Eastern province, Kitui County<sup>1</sup>. The topography of the district can be divided into hilly rugged uplands and lowlands. The few hills in the district rise as inselbergs in the plains, rising to an altitude of 1,747 meters above sea level. Temperatures are high throughout the year with maximum ranging from 28°C – 34°C and minimum between 14°C and 22°C. The district has two rainy seasons between March – May (long rains) and October – December (short rains) with the rest of the year remaining dry. Mean annual rainfall ranges from 400mm to 800 mm and is highly erratic between years with the short rains being more reliable than the long rains (GoK 2008).

The climate is hot and dry for the greater part of the year and falls under two climatic zones; semi-arid and arid. Mwingi District has 65.5% of its population below the food poverty line while 58.5% of the households in Mwingi are food poor (GoK, 2008). Similarly, 62% and 66.5% of the people and households in the district, respectively, are facing absolute poverty (GoK,

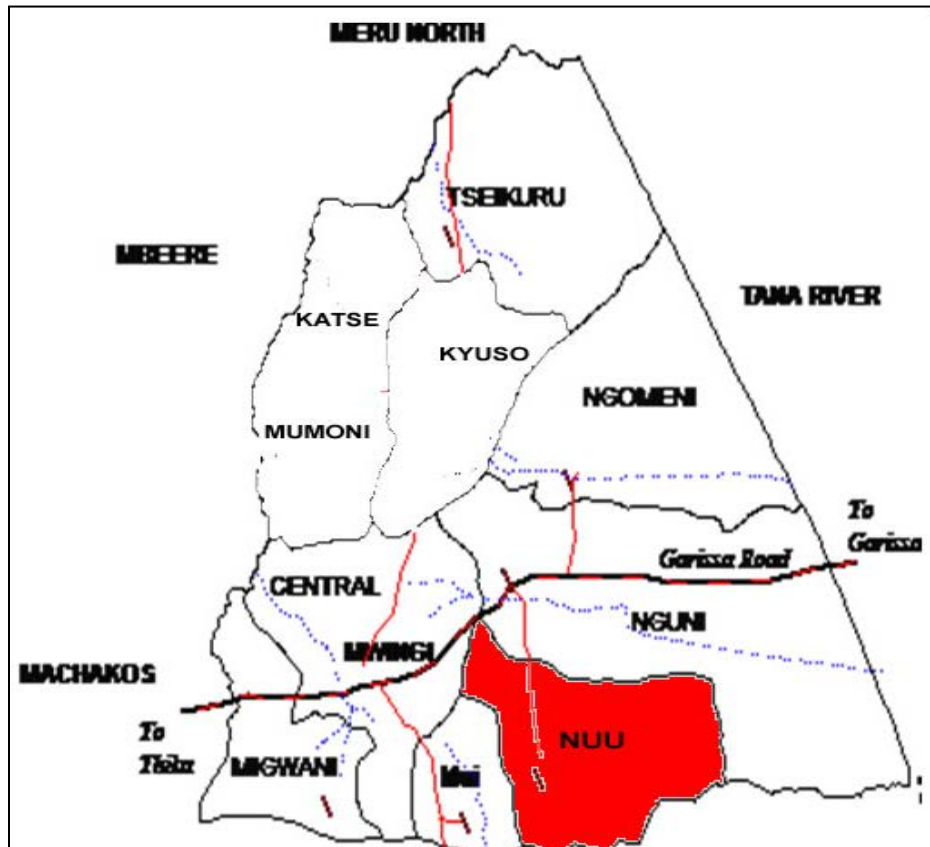
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<sup>1</sup>The administrative system in Kenya was changed in 2010; from provinces to counties after promulgation of the new constitution. Every District now belongs to one of the 47 created counties.

2008). Poverty levels and food insecurity have been aggravated by recurrent droughts which have caused severe crop failures and animal deaths, resulting in food shortages.

The main crops grown in the district are the drought resistant crops; sorghum, pearl millet, pigeon peas, cowpeas, green grams and cassava. These crops are mainly grown at subsistence level of small-scale farming. Indigenous Livestock farming is however the major economic activity with about 90% of the area being suitable for extensive livestock production.

**Figure 1: Map of the study area**



## *2.2 Data collection*

Comprehensive information was collected to assess the economics of harvesting and marketing indigenous fruits and the socio economic characteristics that influence participation in trade of indigenous fruits. This was done through a survey carried out in NuU division, Mwingi district. NuU division was purposively selected because of the widespread natural occurrence of indigenous fruit trees. The sampling was then conducted as follows; a random sample of the locations in the division was conducted where two locations out of the seven were randomly selected: Mutyangome and Yumbu. Random sampling was then carried out in the two locations to arrive at 120 households. The 120 households which were randomly selected were interviewed using a semi-structured pre tested questionnaire. The respondents were head of households, either male or female. The interviews were conducted by trained field assistants who were

residents of the area. The data, which was collected in March 2011 covered the period from January 2010 to December 2010.

### 2.3 Data analysis

The analysis of socioeconomic factors influencing the decision of a household to participate in trade of indigenous fruits was based on choice theory. Household's decisions are based on expected utility where households are assumed to be utility maximisers. The decision to harvest indigenous fruits for trade was predicated on higher expected utility.

Several qualitative choice models can be estimated, Logit and probit analyses are preferred when qualitative choice models are to be estimated (Greene, 2000). The logistic model was used for this study as it predicts the logit of the response variable (Y) from the explanatory variables (X). The logit is the natural logarithm (ln) of odds of Y, and odds are ratios of probabilities ( $\pi$ ) of Y occurring to probabilities ( $1-\pi$ ) of Y not occurring. The dependent variable (Y) is a dummy variable with two categories of choices, 1 if the household participates in harvesting indigenous and 0 if the household does not participate.

Generally, the logistic model is specified as:

$$\ln\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_k x_{ki}$$

Where  $\beta_0$  is the intercept and  $\beta_1, \beta_2 \dots \beta_k$  are the coefficients of the independent variables  $x_1, x_2 \dots x_k$ .

The model contained nine explanatory variables (gender, age, household size, marital status, employment, income, location, market distance, education). Correlation analysis was applied to check for co-linearity between the explanatory variables. The significance of the logistic regression parameters and how well the data fits the model was assessed by the chi-square likelihood ratios, deviation tests, omnibus tests, Hosmer–Lemeshow's test and Wald's statistics.

To assess the profitability of harvesting indigenous fruits for trade, partial budgets were developed and gross margin analysis performed. The Benefit Cost Ratios (BCR) and returns to labour were also estimated.

## 3. Results and Discussions

### 3.1 Market participation

Table 1 below represents participation of the sampled households in the indigenous fruits' market. Out of the 120 sampled households, 81 households participated in the sale of indigenous fruits. This represents 68% of the sampled households. The households either engaged in the sale of one of the fruits, two or all the three fruits. Table 1 has classified households' participation in

the trade of indigenous fruits with respect to the market type. The percentages represent the number of households that either participated in local or distant markets<sup>2</sup>.

**Table 1: Market participation of selected indigenous fruits in Mwingi District, Kenya.**

	Local market (%)	Distant market (%)
Baobab (n=66)	75.75	24.25
Tamarind (n=46)	84.78	15.22
Chocolate berry (n=47)	95.74	4.26

As shown in table 1, among the three types of fruits, baobab had a greater tendency to trade in distant markets (24.25%) than tamarind (15.22%) and chocolate berry (4.26%). This could be attributed to the long shelf-life of the baobab fruits and the high demand in the distant markets especially the urban centers. Chocolate berry is a perishable fruit and it is majorly traded within one week after harvesting, this makes the logistics of transporting to distant markets complex unless value addition efforts are made. Otherwise, the three types of fruits were mainly sold in local markets as illustrated in table 1. However, even though it is reflected that most harvesters traded in the local market, it was noted that the buyers in these local markets were mainly middlemen. The middlemen bought from the local traders at low prices and transported the fruits to distant markets where they made higher margins from the sales.

Children and women were the major traders of indigenous fruits in the households. Women were reported by 58% of the households who participate in trade of indigenous fruits to be the major sellers of indigenous fruits. Children were reported by 40% of the households while the male by only 2%. This is the case because women are the major players in small businesses which are considered less labour intensive in the study area. The men on the other hand take pride in labour intensive activities which albeit could be low return. Children play a role in assisting their parents and selling fruits in the market is one of those roles that they play.

### *3.3 Constraints in marketing indigenous fruits*

**Table 2: Challenges in marketing indigenous fruits.**

Challenge	Percent
Lack of market access	45
Low prices	30
High transport costs	13
seasonality of fruits	2
Perishability	10
Total	100

<sup>2</sup> Local markets were defined as those within the district while the distant were outside the district. Mombasa, Garissa and Nairobi were identified by the respondents as the major distant markets for indigenous fruits.



Table 2 shows the challenges faced by respondents in marketing indigenous fruits. Among those who traded in indigenous fruits, 45% noted poor sales due to lack of market access as the major challenge. Many of the households felt that if they could access distant markets, they would fetch higher prices. Identifying markets and the logistics associated with transporting the fruits to the final buyers was out of reach for most of the harvesters. As a result, they traded in the local markets where prices were low. Seasonality of the fruits was not a major challenge to most of the respondents, only 2% of the respondents reported seasonality of the fruits to be major challenge. Indigenous fruits though seasonal are known to always produce even when there is shortage of rains and crops have failed to grow.

### *3.4 Gross Margin Analysis*

Partial budgets for both the local and distant market are presented in table 3 below. Valuation of family labour has always elicited great debate amongst many economists. Fox *et al.* (2000) suggested three scenarios of dealing with family labour in his paper on economic viability of water harvesting in rural Kenya and Burkina Faso. The three family labour costs used by Fox are full opportunity cost, alternative opportunity cost and zero opportunity cost. Full opportunity cost takes the value of labour to equal the daily labour wage. Alternative opportunity cost is the value of wage equivalent that someone has forgone for not being engaged in the alternative activities. Zero opportunity cost is when the family labour is considered zero which assumes that, due to unemployment, the alternative activity for labour is idle. In this paper, the family labour was valued at full opportunity costs although most households utilized family labour to harvest and sell indigenous fruits. The time that the family members use for harvesting indigenous fruits could likewise be used for other income generating activities, hired out as labour or even for leisure. The male family members mainly carry out the harvesting of the fruits from the trees while the female members participate in shelling, transporting to the market and the actual sale of the fruits<sup>3</sup>

As shown in table 3, the gross margins in both local and distant markets were highest for the baobab fruits (KES 1300 and 1770 per bag, respectively) as compared to the other two fruits. Surprisingly, the margins from distant market were much higher for all the three fruits than the local market. For instance, the gross margin for baobab fruits in the distant market was 27% higher than the local market. The chocolate berry fruits reported the least gross margins in both markets and this could be attributed to the low demand of the fruits. The tamarind fruits on the other side were found to be labour intensive especially during shelling and bagging.

There is no initial investment required in harvesting of the fruits; as a result, the gross margins for all the three fruits are quite high as compared to the associated costs (table 3). The indigenous fruit trees are readily available in the forests and some in the farms. During land clearing, most

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<sup>3</sup>Although this is the common occurrence, there are incidences where these roles are interchanged and one gender does all the activities of harvesting and trading.

households rarely cut down the indigenous fruits especially the baobab tree as it is culturally considered a taboo.

**Table 3: Gross Margin Analysis for indigenous fruits (KES/ 100 Kilogram bag)**

	Local market			Distant market		
	Baobab	Tamarind	Chocolate berry	Baobab	Tamarind	Chocolate berry
Revenue	1500	1400	1200	2200	2000	1500
Cost of harvesting	30	30	30	30	30	30
Cost of shelling & bagging	140	170	40	100	150	40
Cleaning cost	0	0	100	0	0	100
Transport Costs	30	30	0	300	300	150
TVC	200	230	170	430	480	320
<b>Gross margin</b>	<b>1300</b>	<b>1170</b>	<b>1030</b>	<b>1770</b>	<b>1520</b>	<b>1180</b>
<b>Benefit cost ratio (BCR)</b>	<b>6.5</b>	<b>5.09</b>	<b>6.06</b>	<b>4.12</b>	<b>3.2</b>	<b>3.69</b>

1 KES= 85 USD

Interestingly, the benefit cost analysis (table 3) reported high ratios of greater than 3.0 for all the three fruits under study. This implies that the expected benefits are three times higher than the costs. The baobab fruits reported the highest benefit cost ratio (6.5) with tamarind which is more labour intensive reporting the lowest (6.06). The low costs of harvesting the indigenous fruits make it easier for households to venture into this trade as it requires little or no capital to start. All the three fruits under study were therefore found to be profitable to harvest for sale. . As expected, selling the fruits in the distant market was more profitable than the local market as the benefit cost ratios for all the fruits were higher in the distant market than the local market.

### *3.5 Socio economic factors influencing participation in harvesting Indigenous Fruits for trade*

The overall assessment of the logistic regression model showed that the data fitted well to the model. The Hosmer and Lemashow test was not significant and the Cox & Snell and Nagelkerke  $R^2$  were greater than 0.5 (table 4). The model correctly predicted 97.5% of the data.

The variables used in the model were generated from literature review, theoretical information and through correlation matrices. Where correlation between two variables was above 0.6, one variable was to be dropped; however, the generated correlation matrices did not show any correlation among the variables.

**Table 4: Logit estimates**

Variables	B	S.E	Wald	df	Sig.	Odds ratios
location	1.506	1.930	.609	1	.435	4.509
gender	3.048	2.504	2.059	1	.047	21.071**
Age	.042	.082	.268	1	.605	1.043
Marital status			3.103	3	.376	
Single	-27.038	9599.945	.000	1	.998	55260886.129
widowed	4.674	12.606	.137	1	.711	107.1
divorced	7.125	3.184	2.899	1	.089	0.903*
education	.060	.242	.061	1	.805	1.061
hhsz	2.450	.877	7.799	1	.004	11.589***
employment			3.630	3	.304	
formal	-5.639	3.288	2.942	1	.086	56.069*
pensioner	-7.053	3.981	3.139	1	.076	6.594*
Self	4.369	2.756	2.513	1	.113	78.968
income			6.897	2	.032	
High	-13.919	1.022	5.342	1	.021	29.000
Middle	-28.902	2.256	6.593	1	.010	22.620
mktdistance	-.898	.530	2.870	1	.090	.407

\*indicates  $p < 0.1$ ; \*\*indicates  $P < 0.05$ ; \*\*\* indicates  $P < 0.01$

Cox & Snell  $R^2 = 0.67$ ; Nagelkerke  $R^2 = 0.935$

Overall percentage of right prediction = 97.5%

Hosmer and Lemeshow test (Chi square = 0.071, prob. = 1.000).

-2 log likelihood = 18.148

The results of the model in table 4 indicate household size to be positively associated with the decision to participate in the trade of indigenous fruits. An additional one member into the family increased the odds of the household harvesting indigenous fruits for trade by 11.59 ( $P < 0.005$ ). A bigger household would probably increase the cash needs of feeding an extra mouth. It is therefore very likely that a household would seek for other income generating activities and harvesting of indigenous fruits being one of those ready alternatives. These results are consistent with other studies in Ethiopia and Burkina Faso where dependency on Non Timber Forest Products was found to be significantly positively related to household size (Mamo, *et al.*, 2007; Kamanga *et al.*, 2009; Lingani, *et al.*, 2009; Völker *et al.*, 2010).

A kilometer increase to the market would decrease the likelihood of a household to participate in harvesting indigenous fruits by 0.40%. This is due to the additional cost and time that would be required to transport the fruits. While this finding agrees with a study by Mamo *et al.*, (2007), Ndoye *et al.*, (2000) found that market access increased the ability to market other crops and so lowered forest incomes.

Education has been found by various studies to be a significant negative determinant in extraction of indigenous fruits and other Non-Timber Forest Products for either food or income (Gunatilake, 1998; Adhikari *et al.*, 2004; Lingani *et al.*, 2009). However, in this study, just like a study by Mamo *et al.*, (2007); education of the household head was found to be an insignificant variable in influencing participation of a household in trade of indigenous fruits.

The marital status of the household head was critical in influencing the decision of the household to engage in harvesting indigenous fruits for trade. It was 0.9% more likely for a household whose head is divorced to engage in harvesting indigenous fruits than for a household with a married head.

At 90% confidence level, the formally employed and pensioners would less likely (56% and 6.5% respectively) participate in harvesting indigenous fruits for sale as compared to full time farmers (reference group). Since the study area is prone to recurrent droughts, full time farming therefore offers very low opportunities for income as compared to formal employment or pension money. Low incomes from farming drive farmers to seek for alternative income sources such as harvesting indigenous fruits.

The odds for both the high and middle income earners participating in harvesting indigenous fruits for trade were higher than the reference's group (low income earners). The likelihood of the high and middle income earners' participating in trade of indigenous fruits was 29% and 22% respectively, higher than the low income earners ( $p < 0.05$ ). The low income earners take up trade in indigenous fruits as a coping strategy to provide not only food but the much needed income to purchase household items. Other households reported to utilize incomes from trade of indigenous fruits to purchase livestock and even school items for their school going children. Household income level has been found by various studies to be important in determining harvesting and utilization of indigenous fruits and other Non-Timber Forest Products (Caviglia and Sills, 2005; Kamanga, 2009)

The likelihood that a female household head would participate in extraction of indigenous fruits for sale was 21% ( $p < 0.05$ ) higher than the males. The women are the major contributors of farm labour. When farm production fails due to drought, they opt to engage in trade of indigenous fruits to supplement the family income. Just like other studies conducted by Shackleton *et al.*, (2006) and Ayisso *et al.*, (2009) in South Africa and Nigeria respectively, this study found gender of the household head to be a significant determinant in harvesting indigenous fruits for trade.

## **5. Conclusions and Recommendations**

Harvesting indigenous fruits for trade was found to be a profitable activity in the area. The income derived from these fruits play a major role in supplementing the cash needs of the households. As a result of the recurrent droughts experienced in the area, some households

revealed to almost depend entirely on indigenous fruits for food and income especially when all the other crops have failed. Trade in the three indigenous fruits reported high gross margins with the highest margins being reported in the longer shelf-life fruits; baobab. It should be noted that the analysis were based on the opportunity costs of labour, higher margins would be expected if the actual costs incurred by the households were used.

Distant markets yielded higher returns than the local markets; however, challenges especially in market access were cited as a major hindrance in exploring these markets. Efforts to increase commercialization of the fruits will contribute substantially to the livelihoods of the communities in the area. Collective action would be recommended as a means to expand the market. Involvement in collective action facilitates pulling together of resources, this would help the traders access high return markets. There is need for the traders to be empowered and capacity built to enable them access high returns markets in order to reap high benefits from their engagements.

The role of women in supplementing the income of the households and even being breadwinners can no longer be assumed especially in the rural set up. Women have taken up trade in indigenous fruits as an alternative source of income, they provide more labour hours in extraction and trade of indigenous fruits.

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