Labour allocation patterns of rural households to agriculture and forest activities in Kakamega district, Western Kenya

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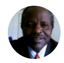
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Abstract

Communities adjacent to forest are faced with a challenge of balancing their labour allocation decisions to the different household activities. This study was done around Kakamega forest in Western Kenya and examined empirically the factors influencing households' labour allocation to agriculture, forest and non-farm activities. A semi-structured questionnaire was used to collect data from a random sample of 140 households, on household characteristics and key policy parameters affecting labour allocation. A labour share model similar to standard models of commodity or factor demand was used in estimation. The study findings indicate that wage returns on each activity positively influence labour allocation. Additionally education level of household head has a negative influence on forest and non-farm labour shares while positive on agriculture labour share. Other factors like size of landholding and family size all affect household labour allocation decision. These findings have implications for the type of policies needed to support improved labour supply decisions in the rural sector. Investment in livelihood activities in the rural set-up would largely draw much labour to this sector, hence reduced pressure in the forest ecosystems.

Key words: Labour allocation, labour share, Kakamega Forest

1. Introduction

Agriculture has, for many years, formed the backbone of Kenya's economy: the agriculture sector contributes about 30 per cent of the Gross Domestic Product (GDP) and accounts for 80 per cent of national employment, mainly in the rural areas. In addition, the sector contributes more than 60 per cent of the total export earnings and about 45 per cent of government revenue, while providing for most of the country's food requirements. The sector is estimated to have a further indirect contribution of nearly 27 per cent of GDP through linkages with manufacturing, distribution, and other service related sectors. Kenya's agricultural sector directly influences overall economic performance through its contribution to GDP. Periods of high economic growth rates have been synonymous with increased agricultural growth. In addition, the sector forms the basic source of livelihood for most of the rural poor who constitute more than 60 percent of the population.

Forests on the other hand provide many products and services to rural populations. These include among others wood for fuel, fodder for livestock, and building materials. In Kenya, the forest cover, according to recent estimates (Green Belt Movement, 2008), stands at less than 2 percent. In spite of this, dependence on forests is still very high. Mogaka et al., (2001) notes that an estimated more than 3 million people living adjacent to forests in Kenya depend on them for provision of households’ wood and non-wood products needs. Most of these populations are to be found in rural areas, where they live in a biomass based economy in which local land resources provide for the bulk of their survival needs.

Kakamega forest in Western Kenya is one such forest whose sustainable existence has been under constant threat from the pressure exerted on it by the rural population living around it. The forest has elicited lots of attention due to its uniqueness; being the only remaining patch of Kenya's Guineo-Congolean rainforest that spans from West and Central Africa. The forest is also located in one of the world's most densely populated rural areas with an average population density of 600 people km^2 (Blackett, 1994). A rapidly growing population occupies 57 forest-adjusted villages and thus places pressure upon Kakamega Forest (KIFICON, 1994).

The high population growth is leading to repeated subdivision of land parcels and has rendered the traditional agricultural system of fallow rotation almost unworkable as the pressure to continually cultivate all the available land increases. As a result, the forest has become an ever more important source for satisfying the daily needs of the local people. Continual pressure being exerted to the forest threatens its existence. Being one of the critical livelihood sources for the rural communities around the forest, its role in improving household welfare cannot be overlooked. With a declining trend in the availability of forest products, rural communities face a critical decision on how to allocate their constrained labour to the different productive activities within the household. Prepositions have been made from other studies that in the face of scarcity, households will allocate more labour to collection of environmental products at the expense of agricultural activities. It is against this background that the present study was conducted.

The main objective of the study was therefore, to investigate underlying factors influencing labour allocation to agriculture and forest activities of rural households residing adjacent to Kakamega forest. During the survey however, it became evident that the non-farm wage work sector could not be assumed away due to its immense contribution to the households' livelihood strategies. The factors studied are very crucial in informing policy debate on improvement of the welfare of smallholders considering that dependence of rural households on forest resources is a concern to policy makers. If indeed labour allocation is influenced by existence of forest products then there is a strong case for the protection of these resources. Interventions that help households save time by increasing the availability of environmental products or by allowing more efficient use of such products may be quite beneficial.

2. Theoretical framework

In investigating underlying factors influencing labour allocation to agriculture, forest extraction and non-farm work, this study draws from the economic theory of farm households as explained by Singh *et al*, 1986. The household model is desirable as it explicitly accounts for the fact that many low-income farm households are both producers and consumers of agricultural and forest goods, and that markets for key factors and products typically are weak in rural areas of developing countries. This indicates that specification of the production and consumption of subsistence households in most developing countries is interdependent and non-separable. This interdependency assumption and thus non-separatability implies that household resource allocation is decided simultaneously, rather than recursively (Heltberg *et al*, 2000). The joint production and consumption of agricultural commodity and forest products suggests the use of a non-separable household model, rather than a pure demand model (Singh *et al* 1986).

A representative household living in the periphery of a protected forest is considered. It is assumed that members of the households are engaged in agricultural activities, forest gathering activities and non-agricultural/non-forest activities. The objective function of the household is to maximize utility by choosing labour allocation to specific activity, consumption and inputs. The household solves;

$$\underset{L,C_i,X}{Max}\, U = U(C_j, N; H) \quad j = a, f, o \qquad 1$$

where $C_j = C_a, C_f \, and C_o$

where utility U is derived from consumption of agricultural commodity (Ca), forest product (C_f), off-farm good (C_o), and leisure (N). H are household characteristics influencing preferences. Household leisure-time is not modeled since the labour-leisure margin in most rural households is assumed to be negligible (Adhikari 1996).

The household maximizes utility subject to production function for agricultural commodity,

$$Q_a = Q_a\{L_a, X, A_O\} \qquad 2$$

where Q_a is agricultural production, assumed to be a function of labour L_a, purchased inputs like fertilizer X and household's land endowment A_O. Households use their own male and female labour for agricultural production, and may also hire both male and female labour. Same-gender hired and own-household labour inputs are assumed to be perfectly substitutable, although male labour and female labour in general are not. The households are also assumed to be risk averse.

Similarly, the production function for forest product is;

$$Q_f = Q_f(L_f, F) \qquad 3$$

where Q_f describes the production of forest good. L_f is the household's labour in extracting forest product and F is distance to the forest.

The production function for non-farm/non-forest good, which require only labour (L_o) for production, is given by

$$Q_o = Q_o(L_o) \quad (4)$$

The household's budget constraint is defined as,

$$Y = \sum_j \left[(p_j Q_j - p_j C_j \right] - p_X X + vL_V \quad (5)$$

Households are assumed to engage in a competitive market for agricultural products where they can sell and buy at market prices p_i assumed to be exogenous. Farm inputs (X) are purchased but not sold. The household may also buy and/or sell household labour at market wage rate v, though labour market is thin.

The households' time constraint therefore becomes,

$$T - N = \sum_j L_j \quad (6)$$

The Lagrangian of the household's maximization problem is;

$$L = U(C_j, T - \sum_j L_j : H) + \lambda \begin{bmatrix} [p_a Q_a (L_a, X, A_O) - p_a C_a - p_X X] + [p_f Q_f (L_f, F) \\ - p_f C_f] + [p_o Q_o (L_o)] \end{bmatrix} \quad (7)$$

Whose expressions after rearranging becomes;

$$\frac{\partial U(\cdot)}{\partial C_a} = \lambda p_a \quad (8a)$$

$$\frac{\partial U(\cdot)}{\partial C_f} = \lambda p_f \quad (8b)$$

$$\frac{\partial U(\cdot)}{\partial C_o} = \lambda p_o \qquad \text{8c}$$

$$\frac{\partial U(\cdot)}{\partial N} = \lambda p_a \frac{\partial Q_a(\cdot)}{\partial L_a} \qquad \text{8d}$$

$$\frac{\partial U(\cdot)}{\partial N} = \lambda p_f \frac{\partial Q_f(\cdot)}{\partial L_f} \qquad \text{8e}$$

$$\frac{\partial U(\cdot)}{\partial N} = \lambda p_o \frac{\partial Q_o(\cdot)}{\partial L_o} \qquad \text{8f}$$

$$p_a \frac{\partial Q_a}{\partial X} = p_X \qquad \text{8g}$$

Note that at equilibrium, ratios of the marginal products of C_a, C_f and C_o will equalize with their price ratios. Equations 8d-8f indicate that, at the optimum, households allocate labour across activities so as to equate the marginal value of household leisure with that of time spent on each productive activity. Expressions for labour supply; input demand and commodity demand can be derived as functions of all exogenous variables; p_i, H, A_O, F, T.

3. Materials and Methods

3.1 Study area

The field survey was carried out around Kakamega Forest, situated in Kakamega District in Western Province of Kenya. The forest area is drained by two main river systems, the Isiukhu River to the north and the Yala River to the south. The forest is the only remaining rain forest in Kenya and is the furthest east remnant of the Guinea-Congolean rain forest. According to the 1994 welfare monitoring survey, 52% of the population in the district was below the poverty line meaning that they can hardly afford basic necessities like food, shelter, clothing, education and other amenities; as such they rely heavily on the forest to supplement their daily necessities. This region has also been considered by the Kenya Woodfuel and Agro-forestry Programme (KWAP) as one of the areas that could benefit most from policies that target improvement of forestry projects due to its high population, good rainfall and high agricultural potential.

3.2 Data and sampling

Data used for this study was collected between the months of March and May 2007. The target population was the forest adjacent community which basically refers to the people residing along the boundary of the forest and its proximity. The current study was undertaken within approximately 5 km radius around the forest. This distance was purposively chosen for convenience since an earlier reconnaissance survey in the study area indicated that there were progressively fewer people that extract beyond 5km stretch from the forest (Guthiga and Mburu, 2006)- they had used a distance of 10km around the forest. A census of households within the study area carried out with the help of administrative village heads and other local leaders generated a sampling frame consisting of approximately 34,000 households residing within approximately 10km radius of the forest. A random sample of 378 households was generated from the sampling frame using systematic random sampling. The sampled households were randomly interspersed in the study area. From the random sample generated by the project, a total of 140 households were selected for the actual survey- this were actual households occurring between a radius of between 1-3.5 km from the edge of the forest. Out of the interviewed households a total of 134 households were included in the final analysis, 6 households were dropped from the sample either due to incomplete responses or internal inconsistency.

3. 3 Empirical methods

The empirical model used to investigate factors influencing how labour was being allocated is indicated below. Labour shares were taken as the dependent variables. The model is a system of three jointly estimated labour share equations (for fuelwood collection, agriculture and non-farm activities) where each labour share is a function of selected household characteristics. Following Shively et al (2005), our model takes the form

$$L_{ij} = \alpha_i + \sum_j \beta_{ij} LOG(P_j) + \eta_i K + \gamma_i E + \chi_i A_o + \delta_i F + \psi_i S + \varepsilon_i \qquad 9$$

where subscripts i represent individual households and j represent activities undertaken. L is labour share to each activity, while P_j represents labour returns from each activity, K age of the household head, E education of the household head, A_O size of landholding, F distance to the forest, S household size and ε_i error term. The labour share model is similar to standard models of commodity or factor demand, like the Almost Ideal Demand Systems (AIDS) developed by Deaton and Muellbauer (1980b).

As in the AIDS model, parameters of the labour share system are constrained across equations. If the system of equations is complete, then, by construction, the observed labour shares will sum up to one. In order to ensure that predicted labour shares also sum to one, the following restrictions are imposed;

$$\sum_j \beta_{ij} = 0 \qquad 10$$

$$\sum_j \eta_i = 0, \ \sum_j \gamma_i = 0, \ \sum_j \chi_i = 0, \ \sum_j \delta_i = 0 \text{ and } \sum_j \psi_i = 0 \qquad 11$$

$$\sum_j \varepsilon_i = 0 \qquad 12$$

$$\alpha_a + \alpha_f + \alpha_o = 1 \qquad 13$$

The homogeneity restriction (10) implies that a given labour share is invariant to proportional changes in all prices. Constraint (11) requires that the individual effects of changes in explanatory variables on labor allocation are offsetting such that the net effect of a change in a given explanatory variable on labor allocation is zero. Constraint (12) requires error terms across equations to be linearly dependant; and constraint (13) combined with the so-called adding-up restrictions ensures that the estimated labor shares sum to one. While an OLS estimate of these equations would be consistent and unbiased, the estimation method developed by Zellner (1962) for Seemingly Unrelated Regressions (SURE) provides estimates that are more efficient. During estimation, one of the equations is dropped from the model to avoid singularity of the disturbance covariance matrix (Sadoulet and de Janvry, 1995).

4 Results and discussions

Table 1 provides descriptive statistics for the variables used in the model. An iterative seemingly unrelated regression which provides estimates that are invariant to the dropped equation was used in estimation of the labour share equations. In controlling for sample selection bias, the Inverse Mills Ratio was generated for each household in every share equation before estimation. The ratio was then additively included as a regressor in the subsequent share equations. This was to ensure correction for selectivity bias in cases where no observations were made. The Inverse Mills Ratio

(IMR) was not statistically significant in any of the equations which suggest that sample selection bias was not an issue.

Table 1: Summary statistics for variables used in the model

Variable	Variable definition	Mean
P_f	Imputed shadow wages for forest activities	2.553 (1.903)
P_a	Imputed shadow wages for agricultural activities	3.060 (2.767)
P_o	Imputed shadow wages for non-farm/non-forest activities	5.276 (0.185)
K	Age of household head(years)	51.126 (15.373)
E	Education level of head (no. of years spent schooling).	7 (4.254)
A_O	Size of household landholding	3.369 (2.926)
F	Distance to the forest	2.431 (1.763)
S	Household size (no. of persons)	5.244 (2.135)

Note: Standard deviation in parentheses

Table 2 show factors that influence how households allocate labour to the activities studied. The preceding discussion looks at the significant variables only. Labour returns from each activity show positive relations with respective labour shares. However, cross-wage effects between the different activities are negatively related. The positive sign on an activity's labour returns in the labour share equations indicate that households that obtain higher returns from that activity allocate a greater share of household labour to it and vice versa. It is thus plausible to conclude that households respond positively to increased wages from an activity.

The effect of education is negative in forest labour share, positive in agriculture share and negative in non-farm labour share. The variable is significant in all the shares. In relation to the forest sector, a plausible explanation is that education signals employers about workers' potential productivity, increasing the chances of their being hired into attractive non-farm, non-forest activities thus reducing labour allocation to the less remunerative forest sector. This finding agrees with Gunatilake (1998) who concluded that education level of the family is negatively related to dependency on the forest ecosystem.

Table 2: Estimation results for the Labour Share equations.

	Forest Labour Share	Agriculture Labour Share	Non-farm Labour Share
Constant	-.106	.475	.631
P_f	.001**	.001	-.035
P_a	.001	.028*	-.028*
P_o	-.035	-.028*	.082
K	.002	-.001	-.001
E	-.005**	.013*	-.008**
A_O	-.005*	.014*	-.009
F	-.002	.001	.001
S	.008**	-.018*	.010

* Significant at 5% level, ** significant at 10% level

The result for non-farm labour, however, contradicts the norm. Normally, it is expected that educated workers will find high paying jobs, locally or in secondary cities (World Development report, 2008). Most of the off-farm activities within Kakamega do not require any skilled labour- falling under the informal sector commonly referred to as the *jua kali* sector.

The effect of landholding on forest share is negative and significant, positive and significant in agriculture share and negative in non-farm. Matshe and Young (2004) also found farm size negatively related to amount of time allocated to non-farm activities. Plausible explanations being that households having large parcels of land concentrate most of their labour on farms relative to forest and non-farm activities; and that farmers do undertake non-farm activities because of constraints in getting access to farming land.

The forest distance reveals a negative and insignificant effect on forest share. As distance to the forest increases, households will tend to reduce labour to forest products search. This finding is consistent with those obtained by Cooke (1998) and Amacher et al (1996) in Nepal. Distance is positively related to the agriculture and non-farm shares. More time that could have been spent in going to the forest can now be increased on other productive activities like farming or off-farm.

Household size has significant effects on forest and agriculture labour shares. It is positively related to forest share while being negative for agriculture. A family with a larger labour force can mobilize household labour in forest extraction activities than households with a smaller labour force. There is no restriction on the number of people from a single household who can harvest such products. In this case, households with more members tend to collect a larger portion of such products. The household size has no significant effect on non-farm labour share. Economic rationing of hiring labour has more to do with market wage than family size and composition.

5 Conclusion

This study has demonstrated that households will reallocate labour from one activity to the other if returns from the latter exceed the former. Findings reveal that forest use and non-farm wage work are substitute activities for sample households. Higher returns from forest activities increase the forest labour share and simultaneously reduce the non-farm wage work share. Likewise, as returns to wage work rise, households devote a greater share of their labour to employment and a lower share to forests. Results further indicate that there is less labour reallocation from agriculture activities. It is quite conceivable that agriculture is such a high priority for these subsistence farmers that sacrifices will be made in leisure or other activities before agriculture labour time is reduced. Findings have implications for policies to support improved labour supply decisions in the rural sector.

Optimistically, the positive own-wage effects in each labour share equation suggest that households respond well to production and work incentives, an essential element in economic development. Likewise, negative cross-wage terms in most equations indicate that labour can be drawn away from one sector through return-incentives in another. It is thus plausible to suggest that public sector investment in non-farm wage work is a potential strategy to reduce forest pressure.

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