Implications of Forest Reforms on Agricultural Household Labour Allocation Decisions: Evidence from Kakamega Forest, Western Kenya

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Abstract

The Kenyan government has realized the importance of forests and as such embarked on substantial reforms in the sector in a bid to ensure better management. These efforts culminated into the enactment of a new legislation to guide management of the sector. The new reforms are likely to influence the decision making processes within agricultural households. For instance, it is unclear how the new reforms influence labour allocation decisions within agricultural households. This study therefore sought to investigate how the new reforms among other factors affect labour allocation to different activities within the households. This was done by estimating a labour share model similar to standard models of commodity or factor demand, like the Almost Ideal Demand Systems (AIDS). From the findings, we see that age of the household head, attainment of primary level education and access to the forest significantly influence labour share to forest activities; while returns from farming, age of the household head, primary and secondary education levels of head, household size, forest access and farm size affect farming labour share. Of particular interest is that forest access positively influences labour share to forest extraction while being negative for the farming labour share. The findings depict the importance of NTFPs to the rural livelihoods hence the need to design policies that will ensure complementarity in access to forest products and engagement in other livelihood activities.

Key words: Labour allocation, labour share, forest access, Kakamega Forest

1. Introduction

In the developing countries, forests are of vital importance to the livelihoods of many people, and more so the rural population. Studies (Cavendish, 2003; Angelsen and Wunder 2003; Fisher, 2004) have identified three distinct roles played by forests. These include acting as safety nets during periods of hardship; support of current consumption (complement other incomes and providing regular subsistence use); and a pathway out of poverty through provision of diversification options. Lechapelle et al 2004 observes that access and utilization of forest resources bestows society a sense of empowerment since products obtained therein play a crucial role in the sustenance of livelihoods.

In Kenya, despite the forest cover standing at only 2 percent, they are great reservoirs of biological diversity (Walubengo and Kinyanjui 2010) and livelihood sustenance. Forest resources make substantial contribution to economic development in Kenya. In 2007, the forest sector was estimated to contribute about 1% to the GDP and that more than 10 percent of households living within 5 kms from forest reserves depend on them for subsistence resources (Geller *et al*, 2007). However, this figure grossly misrepresents the contributions of forests to the country's economy as most of the forest products and services are not captured in the national accounting systems. This scenario partly explains why the forestry sector tends to get lower priority in terms of national resource allocation. Studies have suggested that if the direct consumption of wood products in the forms of fuelwood and charcoal coupled with the indirect contributions of forests to watershed management, soil and water conservation and forest products utilization in other economic sectors are considered in the calculation, then the contribution of forestry to the country's GDP could be much higher.

Forest management in Kenya was for a long time the mandate of the State with little or no involvement of other stakeholders at all. This management style proved futile as the country continued to experience high rates of forest degradation. The central state control was found largely unsuccessful, costly and financially unsustainable (Banana et al, undated). This had serious effects on the economy due to the intertwined nature of forestry with other sectors of the economy. Upon realization of the importance of forests in economic development, the government embarked on major reforms in the

forestry sector in Kenya in a bid to increase forest cover and reduce forest destruction and degradation. The reforms take cognizance of the importance of forests to the country's economic development, to meeting subsistence needs, supplying energy, regulating water flows and providing habitat for wildlife which forms the basis of a thriving tourism sector.

The Government has also recognized the critical role to be played by forest-adjacent communities in ensuring that tree cover in the country increases from the current 2% to the recommended 10% (MENR 2007). The new reforms are geared towards ensuring improved farm forestry, intensified dryland forest management, increased private sector engagement in industrial plantations and increased involvement of communities in forest management and conservation. Local communities are considered more effective managers of local resources due to their greater knowledge of local resources and ability to monitor resource and enforce compliance (Ostrom, 1990; Gibson, Williams and Ostrom 2005).

The new reforms are likely to influence the decision making processes within agricultural households. For instance, with some level of access into forests having been allowed under the new reforms, households will definitely have to plan how to allocate labour between forest extraction and other productive activities. But it remains unclear how the new reforms will influence labour allocation decisions hence this study will determine how the new reforms among other factors affect labour allocation to different activities within the households.

This is crucial in ensuring that relevant policies are in place to ensure to formulating policies that would improve on the welfare of smallholders considering that dependence of rural households on forest resources is an issue of concern to policy makers. If indeed labour allocation is influenced by forest products existence then it presents a strong case for the protection of these resources. Projects that allow households to save time by increasing the availability of environmental products or by allowing more efficient use of them may be quite beneficial.

2. Theoretical Model

We explore the popular rural household economic model advanced by Singh et al 1986; Sadoulet and de Janvry, 1995) which provides a basis for analyzing labour supply decisions. 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 including forest product supply, and demand, and on-farm labour allocation is decided simultaneously, rather than recursively (Heltberg *et al*, 2000). The joint production and consumption of non-commercial forest products suggests the use of a non-separable household model, rather than a pure demand model (Singh *et al* 1986).

A household residing near the forest is chosen and an assumption is made that household members are involved in three different activities; extraction of forest products through access to the forest, involvement in farming activities and off-farm wage work. In maximizing utility, the household allocate its labour to these three activities, by consuming products from these activities and inputs. The maximization problem then becomes;

$$U = U(C_j, N; H) \quad j = a, f, n \tag{1}$$

Where (Ca) denotes consumption of products from farming, (C_f) forest products, (C_n) non-farm products, (N) leisure and H a vectors of household characteristics. The utility function is assumed to be ordinal and strictly concave.

The household faces the following constraints;

$$Q_a = Q_a\{L_a, I, A_O\} \tag{2}$$

$$Q_f = Q_f(L_f, F, R) \tag{3}$$

$$Y = P_a(Q_a - C_a) + P_f(Q_f - C_f) - P_n L_n - p_I I$$

[4]

$$T - N = \sum_j L_j$$

[5]

Equation [2] depicts the production function for farm produce, which in this case is assumed to be a function of labour on farm L_a, agricultural inputs I, and farm size A_O. Equation [3] shows the production function for the forest product which is a function of labour used in extracting the forest product L_f, distance to the forest F, and the forest access R. Forest access is a proxy for the new forest reforms. The new reforms allow for some controlled level of access to forest products and even have penalties for violators. The new laws therefore can increase the costs of access to forest products and community management relative to when there was no controlled access. Equation [4] and [5] shows household's budget and time constraints respectively. Households also acquire or dispose labour at market wage $P_n L_n$.

The Lagrangian of the household's maximization problem is;

$$L = U(C_j, T - \sum_j L_j : H) - \lambda \left[Y - P_a\{Q_a[L_a, I, A_O] - C_a\} - P_f\{Q_f[L_f, F, R] - C_f\} + P_n L_n + P_I I \right]$$

[6]

Whose expressions after rearranging becomes;

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

[7a]

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

[7b]

$$p_a \frac{\partial Q_a}{\partial I} = p_I$$

[7c]

$$\frac{\partial U}{\partial L_a} = \lambda p_a \frac{\partial Q_a}{\partial L_a}$$

[7d]

$$\frac{\partial U}{\partial L_f} = \lambda p_f \frac{\partial Q_f}{\partial L_f}$$

[7e]

$$\frac{\partial U}{\partial L_n} = \lambda p_n$$

[7f]

$$Y = P_a (Q_a - C_a) + P_f (Q_f - C_f) - P_n L_n - p_I I$$

[7g]

Equations [7a] through [7c] equate marginal values with prices. Equations [7d] through [7f] indicate that at the optimum, households will allocate labor across activities so as to equate the marginal value of household leisure with that of time spent on each productive activity. Equation [7g] recovers the full income constraint. [1]Expressions for labour supply, input demand and commodity demand can be derived as functions of all exogenous variables; p_j, H, A_O, F, T, R, I.

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[1] The labour supply functions are derived from the first order conditions.

3. Methodology

3.1 Data

The data for this study was collected from communities residing around Kakamega forest in Western Province in the periods between March and May 2007. The data was elicited from a random sample of 150 households using a semi-structured questionnaire. The sampled households were distributed across all the three forest management regimes. The management regimes are the Kenya Wildlife Services (KWS), Kenya Forest Service (KFS) and the Quakers Church Mission (QCM).

3.2 Empirical methods

This section focus on development and implementation of an econometric model used to investigate empirically how forest reforms in Kenya are influencing labour allocation decisions among rural agricultural households. We use access to forest products as a proxy for new forest reforms. The novelty of this study is to determine how the new forest reforms together with other socio-economic factors are influencing decision making at the household level. In so doing, the study takes labour shares as the dependant variables, asking how changes in socio-economic characteristics and forest reforms directly or indirectly affect decisions on labour allocation. As explained earlier, we are assuming that households allocate labour to two different activities; farming and forest products extraction. We employ a systems approach thereby having the empirical model as a system of two jointly estimated labour share equations. Our model takes the form;

$$L_{ij} = \alpha_i + \sum_j \beta_{ij} LOG(P_j) + \eta_i K + \gamma_i E + \chi_i A_o + \delta_i F + \psi_i S + \mu_i R + \varepsilon_i \quad (8)$$

Where subscripts i represent individual households and j represent activities undertaken. L is labour share to each activity, P_j 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, R new forest reforms and ε_i error term. We use identical set of exogenous variables for each share equations. 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

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(1980b). Just like in AIDS model, parameters of the share equations 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;

$$\sum_{j} \beta_{ij} = 0 \tag{9}$$

$$\sum_{j} \eta_i = 0,\ \sum_{j} \gamma_i = 0,\ \sum_{j} \chi_i = 0,\ \sum_{j} \delta_i = 0,\ \sum_{j} \psi_i = 0 \text{ and } \sum_{j} \mu_i = 0 \tag{10}$$

$$\sum_{j} \varepsilon_i = 0 \tag{11}$$

$$\alpha_a + \alpha_f + \alpha_n = 1 \tag{12}$$

The homogeneity restriction (9) implies that a given labour share is invariant to proportional changes in all prices. Constraint (10) 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 (11) requires error terms across equations to be linearly dependant; and constraint (12) 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

4.1 Descriptive results

Table 1 shows summary statistics for the variables used in the paper.

Table 1: Descriptive statistics for variables used in the model

Variable	Mean	Std. dev.
Individual attributes		
Age of head	51.1	15.4
Primary education	0.7	0.5
Secondary education	0.3	0.2
Household size	5.2	2.1
Farm characteristics		
Farm size in acres	3.4	2.9
Access to forest products	0.3	0.4
Distance to nearest forest edge (km)	2.4	1.7
other attributes		
Returns from forest activity	1.6	1.9
Returns from farm activity	2.2	2.0

The household characteristics show that the average age for household heads in this region is 51 years. The average schooling years for household heads is 7 years. This explains why majority of household heads reported farming as their main economic activity. The average farm size owned by households is 3.4 acres. The household size measured in this survey is 5 members. This number corresponds to that reported by Kakamega District Strategic Plan 2005-2010.

4.2 Household time allocation to different activities by season

Table 2 summarizes the household time allocation by season in hours per day. Each activity is thereafter discussed below.

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Table 2: Household time allocation by season (in hours/day)

	Season 1 (Long rains)					Season 2 (Short rains)				
Activity	Men	Women	Children	Hired Men	Hired Women	Men	Women	Children	Hired Men	Hired Women
1	3.1	3.0	3.9	4.7	5.3	2.6	2.1	2.5	3.7	4.3
	(1.3)	(1.4)	(1.5)	(1.4)	(1.8)	(1.1)	(1.4)	(1.2)	(1.7)	(1.7)
2	5.6	5.1	4.9	6.1	6.0	4.1	4.3	4.3	5.6	5.4
	(1.0)	(1.0)	(0.9)	(0.5)	(0.7)	(1.3)	(1.2)	(1.2)	(0.8)	(0.5)
3	3.3	2.9	3.4	5.6		5.0	4.3	4.8	6.7	
	(1.2)	(1.0)	(1.5)	(1.4)		(1.4)	(1.7)	(1.8)	(1.0)	
4	7.7	6.6	7.0			7.7	6.5	6.0		
	(2.0)	(1.1)	(1.4)			(2.0)	(1.2)	(2.0)		
5	6.4	5.5				8.1	6.4			
	(1.6)	(2.1)				(2.1)	(2.0)			

Notes: Standard deviations in parentheses

Activity 1- Forest product collection
       2- Cropping
       3- Livestock
       4- Work for Pay (wages, salary)
       5- Self-employment
Source: Author's computations

Forest collection

From Table 2, it is shown that during the long rain seasons, adult persons in the households spent an average of three hours per day on forest products collection activities. This differs from the two hour average during the short season. However, it is noted that hired labour spent slightly more time in collection. This is because for hired labour, there is a specific quantity that has to be collected which is commensurate with the pay given. No standard unit of measurement exists on terms of agreement for hired labour. The amount depended on local arrangements between the parties involved. Regarding the difference in time allocation for the seasons, this was attributed to the fact that during long rain seasons when there was a lot of rainfall, it took quite some more time to get forest products needed by household members. In the case of fuelwood for instance, households prefer dry wood as fuelwood, which is not always readily available when it rains, and even after collection, wood has to be dried before use which increases the amount of time to fuelwood activities. During the short rain season, when the region relatively receives less amounts of rainfall, the time spent by each household member reduces considerably. Household adult persons will spend an average of two hours, which is slightly less compared to long rain seasons. This period is ideal for wood collection since there is abundance of dry woods in the fields. The findings concur with those reported by Cooke (1998a/b) in Nepal where households reported few hours in collecting environmental products during dry seasons.

Agricultural activities

Results showed that the average households in Kakamega exhibited a heavy reliance on agriculture primarily growing maize, beans, tea, sugarcane, potatoes and rearing of livestock. Over 95% of the local population reported engagement in agriculture. For purposes of exposition, the agricultural activities were mainly divided into cropping and livestock activities. During the long seasons, there are lots of cropping activities.. Household members spend longer hours on the farms. An earlier assumption that was mentioned and is maintained in this analysis is that same gender hired and household labour is considered perfect substitutes; although hired labour was found to spend more time in different activities. On average, adult men spent six hours a day while

their female counterparts spend slightly one hour less on cropping activities. This can be accounted for partly by the difference in physical strength for both men and women; and also by the nature of task division within households. Women in most cases went to the farms some few hours late after the male; it was reported that they usually remain behind to prepare meals and join the rest later. About 78% of the households reported having two planting seasons in a year. The main planting season occurs during the long rains when many crops are planted; including, maize, beans, potatoes, cassava, bananas. In short rain seasons, crops usually planted include, vegetables, cassava and rarely maize. Since crops planted during short rain seasons are not labour intensive, not all household members get involved in them accounting for the few hours noted; time allocation reduces and more labour time and effort is concentrated in other off-farm activities.

For livestock activities, it is noted that during the long rain seasons, household members spent an average of three hours per day taking care of livestock. This is attributed to the fact that during this time, fodder is always found in abundance. Less time is thus required to get fodder for livestock. In addition, there is a lot of green pasture so animals can easily graze. However in short rain, there is less fodder availability hence more time is expended searching for fodder. Besides, a lot of pasture is dry in the fields so the animals have to be grazed away from the homesteads, mostly around the forests or water points resulting in more time and effort vested in livestock related activities.

Off-farm activities

Households had some off-farm opportunities both formal and informal (self-employment). Formal off-farm opportunities include employment positions with government institutions, organisations, and the private sector. About 35% of the sampled households reported engaging in these off-farm activities.

The households also reported cases of self-employment. Activities that were being considered under self-employment include; owning small businesses like kiosks, doing bicycle hire commonly known as '*boda boda*', among others. Comparatively, the short rain season has more hours for men than women in self-employment. Men

are the main breadwinners in their families, so when farm activities are not intense, men tend to concentrate mostly on these off-farm activities.

4.3 Empirical results

We use an iterative seemingly unrelated regression to provide estimates of the share equations. Table 3 shows the model results which capture the factors that affect labour allocation decisions of rural households in Kakamega. From the forest share equation, age of the household head, primary education level of the household head and forest access are significant variables that affect decision to allocate labour to forest extraction activities. Age of the head is positively related to forest labour share. As noted by Kiplagat *et al* 2010, as one gets older he accumulates more knowledge and life skills including on forest use. As such, older household heads might have acquired more indigenous knowledge on the use and importance of NTFPs hence the increased demand for these forest products. Primary education level of the heads is also positively related to forest labour share. Primary education level limits the chances of securing attractive employment opportunities elsewhere. Of particular interest to this study is how the new forest reforms influence labour allocation decisions. The forest access variable is strongly and positively significant. The implication is that access to forest increases households' chances of allocating more time to extraction activities. Whether this time comes at the expense of time to other productive activities remains an important research question to be addressed.

Labour share to farming activities on the other hand had returns from farming, age of household head, size of land holding and forest access being significant. Returns from farming activities are negatively related to labour allocation to farming. This implies that as ones income from farming increases, less time is dedicated to farming. Though a surprising finding, it is plausible to think of it in terms of diversification. Considering the risky nature of smallholder agricultural production, farmers tend to diversify by ploughing back income from farming into other productive activities. This assertion is confirmed by the positive and significant variable for returns on farming activities in the off-farm labour share. As income increases from farming, more time is devoted to off-farm activities.

Table 3: Estimation results for the Labour Share equations.

Variable	Forest labour share	Farming labour share	Off-farm labour share
Constant	-.2054069	.7936317*	.4117753
Forest activity returns	-.0010131	.0072035	-.0061904
Farming activity returns	.000475	-.0389399***	.0384649***
0ff-farm activity returns	.0310482	.0636375	-.0946857
Age of head	.0016871**	-.002487 **	.0007999
Primary education for head (1 if yes, 0 otherwise)	.0773144**	-.1227856 *	.0454712
Secondary education for head (1 if yes, 0 otherwise)	.0478305	-.0929505	.0451199
Household size	.0071486	-.0150473 *	.0078987
Size of landholding	-.0040755	.0145499**	-.0104744*
Distance to the forest	.004199	-.0065279	.002329
Forest access	.0676663***	-.0992415**	.0315752

*implies significant at 10% level, ** significant at 5% level, *** significant at 1% level

Survey results show that age of the household head is negatively associated with allocation of labour to farming activities. This suggests that households with older heads are negatively associated with engagement in farming practices. Younger heads of households may obtain a higher share of returns from farming because of their relatively greater physical capacity for arduous labour. Size of the landholding is positive and significant to labour share to farming. Larger farm sizes are associated with higher use of labour hence the need to increase labour time allocated to the farms. The variable for access to the forest is negative and significant to the farming labour share. Forest access is likely to trigger more attention to forest products extraction. As more and more focus is given to the forest, this will definitely impact on the time allocated to farming. The more time that could be spent in farming would now be used to fetch product forest products due to easy accessibility.

5. Conclusion and recommendations

This study has demonstrated how forest access among other factors impact on household labour allocation decisions. Survey findings reveal that age of the household head, attainment of primary level education and access to forest significantly influence labour share to forest activities. All these variables positively

influence labour share decisions to forest activities. Therefore, interventions for reducing forest dependency should target these factors.

Results for farming labour share show that returns from farming, age of the household head, size of landholdings and forest access significantly affect labour allocation decisions. It is clear that those with larger farm sizes tend to work more on-farm. Farm size may be endogenous to off-farm work decisions in that farms tend to also be smaller when farmers pursue off-farm work opportunities. The impacts of less time being devoted to farming as returns from farming increases indicate the need to promote other sectors such as services, commerce and manufacturing in the rural areas. The implication of this finding is that farmers are diversifying resources from farming to other less risky and more productive ventures. Efforts to promote rural economies should be stepped up through provision of necessary incentives that will trigger rural investments. The need to invest in capacity building programmes cannot also be underscored in the rural set-up. Despite education variables not being that significant, increased education will offer good opportunities to participate in the non-farm labour market. Finally, and most important, forest access shows a negative correlation with labour share to farming and positive to forest labour share. This finding depicts the importance of NTFPs to the rural communities bordering forest ecosystems; that they will be willing to risk taking time off from agriculture to the extraction of forest products. This may be indicative of the great role NTFPs play in sustaining local livelihoods in the area. This is intended to inform policy makers on designing policies that will allow sustainable utilization of forest products and at the same time promote sustainable agricultural production. Access to the forest should not harm agricultural production which is also an important venture in terms of ensuring food security.

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