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Analysis of Labour-Use Patterns among Small-Holder Cocoa Farmers in South Western Nigeria

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Abstract: Labour is generally in short supply in peasant production particularly in the rural areas in Nigeria. There is also an unpredictable pattern of use of labour in cocoa farms. This has a negative implication on the level and quality of farm output among small holder farmers. The study investigated the effects of labour use patterns on productivity of cocoa farms in south western Nigeria. Multi-stage random sampling technique was used to select the respondents and the data were analyzed with the use of descriptive statistics and stochastic efficiency frontier function. Many farms (80%) were less than 5 hectares in size and sharecropping was the most dominant of the labour types on the farms. Adult male labour constituted about 69% of the total labour-use on the plantations and the majority of the labour was involved in the application of agrochemicals and harvesting of cocoa pods. The quantity of harvested cocoa beans, size of cleared understoreys and quantity of applied agrochemicals significantly affected (at 5% level) the labour-use efficiency in cocoa plantations. Poor remunerations often discourage prospective farm labour from participating in cocoa production. Better farm labour supply level could be achieved if the remuneration for farm labour is handsomely increased.

Key words: Farm labour, productivity, cocoa farms, efficiency, sharecropper.

1. Introduction

Human labour is about the only main source of labour available to small-holder farmers in Nigeria. Small-holder farmers contribute over 85% of domestic agricultural output in Nigeria. Thus, there is the need to continue to supply food to the ever-growing Nigerian population which anchors on human labour productivity. A researcher [1] noted that hired labour contributes 88% of the total labour-use on farms thus emphasizing its importance in agricultural activities. Other types of labour that could be employed are family labour and exchange labour. Generally, the availability of labour has been found to have impact on planting precision, better weed control, timely harvesting and crop processing [2]. However, Ref. [3] noted that labour is a major constraint in peasant production especially during planting, weeding and harvesting. Again, Ref. [4] observed that rapid growth in population, which increases farm labour supply, exerts so much pressure on land and reduces farm size per hectare. Previous studies [5-7] have shown that available farm labour force comprised mostly the old people (to the exclusion of young men and women within the active working age) thus having a negative impact on agricultural productivity. The increasing absence of young people in farming could be attributed to farm drudgery, absence of social infrastructure, poor farm income and generally low life expectancy in rural areas [8-10]. To cope with the challenges of modernizing agricultural production, therefore, young people need to be motivated to take up farming as a profession and they should be adequately empowered.

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Again, the seasonal relationship between the periodical changes in labour use patterns and different labour operations meant to be timely performed exert a limit to the proportion of household labour that can be depended upon. Nearly all farm works are concentrated in the wet season. A slight delay will be costly, particularly at very short wet season. At such times, demand for labour becomes most alarming. Labour supply becomes the conspicuously scarce factor of production. The responsiveness of the labour supply in the farming communities, both family and hired, to further opportunities for profitable employment alternatives among small-holder farmers poses obstacles to the extended use of labour in agricultural production

Cocoa was first discovered and grown in Mexico and was reportedly introduced into Nigeria from Fernadopo by Squiss Ibaningo in 1874 [11]. The high value accorded cocoa in Nigeria was due to its significant contribution to economic development before the discovery of crude oil in the 1970s. Cocoa could be processed into powder, confectioneries, beverages and wine. It is a major source of foreign exchange and a principal source of raw materials for local industries. In 1960, it contributed 21.6% of Nigeria's foreign exchange earnings, which later dropped to 1.8% in 1982 [12]. The downward trend was attributable to the shift in policy emphasis from agricultural export to petroleum within the Nigerian economy. Cocoa is still the highest foreign exchange earning crop in Nigeria in spite of its present problems in the world market [13].

Through the production, processing and marketing of cocoa, many people are gainfully engaged and able to earn a living. Thus, cocoa is a veritable source of employment. It is a source of income and livelihood to the growers, processors and traders alike. Many government and private agencies employ hundreds of people to complement the efforts of cocoa farmers in direct production, marketing and processing of the commodity for export and local use. Such government and agencies includes: Ministries of Agriculture, Cocoa Development Units, Cocoa Research Institutes, State Produce Inspection Departments (which supply spraying equipment and chemicals to the farmers), Cocoa Cooperative societies and local Licensed Buying Agents (L.B.As.).

Nigeria, once a strong competitor of the world cocoa market, is now ranked the fifth largest producer of raw cocoa beans in the world [13].

According to Ref. [14], cocoa is among the world's highest valued agricultural commodities and accounts for about 57 percent of west Africa's agricultural export. According to him, government's effort in Nigeria has increased cocoa production from 17,000 tonnes in 1990 to more than 400,000 tonnes in 2007.

Therefore, in this study the researchers investigated the labour-use patterns and efficiency among small-holder cocoa farmers in South Western Nigeria.

2. Materials and Methods

2.1 Theoretical Frame Work

Labour-use requirement frontier model is simply defined as the minimum amount of labour required to produce a given level of output. Labour requirement frontier is the target of every firm. Labour-use efficiency is attained when the actual labour employed is on the labour requirement. Given panel data [15] expressed the function as:

$$L_i^* t = f(W_{it}, Y_{it}, Z_{it}, t; \beta) \quad (1)$$

Where L_{it}* is the labour requirement frontier (optimal), Y_{it} is real value added (output), W_{it} is real wage, Z_{ut} is a vector characterizing the production process and the environment (economic policy variables), β is unknown parameters that are associated with determinants of optimal labour-use. Finally, variable *t* denotes time, by which changes in technology was modeled. The first approach is the relationship between the actual labour used by firm, *i* at time *t* (denoted as L_{it}) and the labour requirement function as:

$$L_{it} = L^{*}_{it} eu_{it} \quad (2)$$

Where $u_{it} \geq 0$Y i and t was interpreted as technical inefficiency. $u_{it} = 0$ will mean that the employer uses labour efficiently. i.e, implying that $L_{it} = L_{it}^{*}$. The term $eu_{it} = L_{it}. L_{it}^{*} \geq 1$ measures labour-use inefficiency for Yi and t. This approach was estimated using standard stochastic function technique in which distributional assumptions were made on the inefficiency and random error term. Labour-use can be expressed as;

$$L_{it} L_{it} = L_{it} L^{*}_{it} + V_{it}. \quad (3)$$

Where, V_{it} is the randomly and identically distributed error term with zero mean and constant variance. The labour-use model is specified as a factor input requirement function in which labour is specified to be a function of independent variables. The empirical estimation was based on translog functional from modeling labour equipment function using a simultaneous maximum, likelihood estimation method. In the second approach, estimation of labour-use efficiency was based on the residual from the labour requirement model (3). Using FRONTIER 4.1 [16] and considering the residual plus intercept as a dependent variable, a labour requirement stochastic frontier model [17] will be estimated and efficiency point for each observation will also be computed.

The estimable equation then becomes:

$$V_{it} - \alpha_0 + V_{it} + W_{it} \quad (4)$$

Where the random error term w_{it}, is assumed to be normally distributed with N (*0*, σ^2 W) and independent of the inefficiency u_{it}. The latter are non-negative, that is, random variables assumed to account for the inefficiency in labour-use, given the levels of output and the quasi-fixed capital input. They are obtained as truncations at *0* of the N (m_{it}. σ^2 W) distribution of v_{it} [18].

The degree of labour over use is explained by a time trend, ownership and export orientation;

$$M_{it} = T_0 + T_{it} + T_2 Private_{it} + T_3 Foreign_{it} + T_4 Share_{it} \quad (5)$$

These are variables affecting the labour-use efficiency. M_{it} is the average of the normal distribution truncated at 0. The lower the M_{it} the higher the labour-use efficiency has. This frontier model based on (4) and (5) treated as an invested factor requirement model was estimated by the method of maximum likelihood. Thus, over use of labour is defined as 0. L_{it} measure is > 1, where the amount of excess to 1 indicates percentage over use of labour 0. L_{ut} is estimated by assuming distributional assumptions on the parameters of its distribution. In this study, however, labour use is assumed to be a flexible factor in production process in the cocoa farming economy of the study area.

2.2 The Study Area and Sampling Technique

This study was conducted in the five South western states of Nigeria: Oyo, Ogun, Osun and Ondo/Ekiti states. The sample for the study comprised two hundred small scale cocoa farmers with fifty of them randomly taken from each of the four states in the region. The data used for the study were obtained from the cocoa farmers and their farming households. Other information was obtained from the textbooks, journals, annual reports and so on. The analytical techniques comprised the descriptive statistics and the stochastic labour-use requirement frontier function. Multi-stage sampling technique was used to select the samples.

2.3 Source of Data

Primary and secondary data were used for this study. Primary data were collected using a well-structured questionnaire, administered at the farm level among the smallholder cocoa farmers in the study area. Secondary data on cocoa production and labour-use patterns were obtained from various research publications, statistical bulletins, annual reports etc..

2.4 Method of Data Analysis

2.4.1 Descriptive Statistics

Descriptive statistics such as frequency distribution tables, percentages and averages were used to analyze the pattern of labour-use among farmers in the study

area. The stochastic labour-use requirement frontier function was applied to estimate the labour requirement frontier of the sampled farmers.

2.4.2 Econometric Analysis

Input Requirement Efficiency Measure: Model of labour-use efficiency.

The labour-use efficiency of the cocoa farmers in the study area was estimated using the input-requirement frontier model [19]. Determinants of technical efficiency in small holder crop farming in Nigeria, in which the amount of labour-use is a function of farm output. Farm production process was characterized by the implicit function:

$$H(L, Y, Y_n) = 0 \quad (6)$$

where L is labour and Y_1, Y_n are n outputs produced, using labour. Explicitly, solving for L gives;

$$L = H(Y, Y_n) \quad (7)$$

While the above equation was more simplified to ease quantitative analysis, we therefore have:

$$H(Y_i, Y_n) = e - Y_i \quad (8)$$
$$L$$

Thus, the equation was used as an index of labour-use efficiency. Given the output vector Y_0, demand for labour will depend on the production technology, technical inefficiency and factors outside the control of the farm.

A Cobb-Douglas labour-use frontier was a function that was estimated in the study as given below:

$$L_n L_i = \alpha_0 + \alpha_i \ln Q\,Harvested + \alpha_2 \ln Q\,cleared + \alpha_3 \ln Q\,sprayed + \alpha_4 \ln Q\,fertiliser\,applied + V_i - U_i \quad (9)$$

Where

Li = amount of labour-used (mandays)

Q Harvested = quantity of cocoa beans harvested (Kg)

Q Cleared = area of understorey farm cleared (m^2)

Q Sprayed = volume of agrochemical sprayed (litres)

Q fertilizer applied = quantity of fertilizer applied (kg)

V = the two sided, independent normally distributed random error.

3. Results and Discussions

3.1 Socio-economic Characteristics and Labour-Use Patterns

3.1.1 Farm Size Distribution of the Respondents

The hectarage of a farm dictates the scale of farm productions. It determines the magnitude of labour requirements. As farm size increases, the level of output increases, so also the demand for labour. The distribution of farm size of the sampled cocoa farmers in the study area is given in Table 1. About 80.0 percent of the respondents have less than 5 hectares while 19.0 percent of them operate at medium scale level. This further reconfirms the popularity of cocoa farming particularly at small scale levels. The productivity of cocoa farmers could be improved if the basic production requirements of these small-scale/medium scale farmers are provided. These facilities may include access to land, cocoa seedlings, chemicals/herbicide, and funds.

3.1.2 Labour Types

Table 2 shows that the use of family labour, hired labour, exchange labour and casual labour constituted about 56.0% of labour-use portfolio while the share croppers carried the balance. This implies that the farmers appreciably make use of share cropper labour option in cocoa farming. This notion emanates from the general perception that share croppers are more

Table 1 Distribution of farm size of the respondents.

Farm size (Hectares)	Frequency	Percentage
≤ 5	160	80.0
6-10	38	19.0
> 10	2	1.0
Total	200	100.0

Computed from field data, 2010.

Table 2 Labour types

Labour types	Frequency	Percentage
Family labour	16	8.0
Hired labour	32	16.0
Exchange labour	28	14.0
Casuallabour	36	18.0
Share cropping	88	44.0
Total	200	100.0

Computed from field data, 2009.

honest and dedicated in the discharge of their duties on the farms. This invariably enhances the level of productivity and accruable profit.

3.1.3 Gender Decomposition of Hired Labour (Mandays)

Farm labour offered by hired workers was decomposed on gender line. It reflected the level of participation of men and women workers in cocoa farming activities (Table 3). Results indicate that adult male labour accounted for the largest proportion (69.0%) of total labour-use in all producing region. Adult female and children labour were about 13.0 percent and 16.0 percent respectively.

In terms of variations across the study area, adult male labour are responsible for over 70.0 percent in both Oyo and Ogun states, while 64.0 percent was observed in Osun state. On the other hand, the highest proportion (18.68%) of the female workers was found in Oyo state while the least (0.10 %) was recorded in Ogun state. In Ondo/Ekiti state, largest proportion of children (18.85%) participated in various farming operations. Most of these children took advantage of the school holidays to work on cocoa plantations so as to get some savings to meet some of the expenses when they return to school.

3.1.4 Labour-use by Specific Farm Activities

Allocation of labour usually varies with farming activities. While some tasks require skilled hired labour, household/family labour is sufficient for some. The cost and availability may preclude the use of hired labour of different classes for activities such as understorey clearing, agrochemical spraying, pod harvesting and fertilizer application which are the most labour intensive operations in cocoa beans production. Table 4 presents the use of labour by specific activities in the study area. The use of hired labour was very minimal in all the producing areas for under storey clearing (25.29 percent) and fertilizer application (12.04 percent). This corroborates the finding of Ref. [3] which observed that slashing of vegetative under storey growth in cocoa farms was done just twice in a year prior to the harvesting season while fruiting fertilizers are also applied once throughout a productive season.

Labour was engaged more on agrochemical spraying and cocoa harvesting operations given the averages of 33.39 percent and 29.26 percent respectively. Further analysis indicated that in Oyo State, labour was intensely used in agrochemical spraying. For under storey clearing, Ogun state reported 28.04 percent labour use and highest use of labour for harvesting such that 32.82 percent of labour use was engaged.

3.1.5 Distribution of Labour Supply Inhibitor in the Producing Zones

Despite the dramatic pace of urbanization in South Western part of Nigeria, the incidence of poverty remains higher in the rural than urban centres. This has placed some constraints on labour supply and its distributions. Table 5 shows the distribution of various causes of constraints to labour supply in cocoa plantations in the study area. Poor farm wages (labour payments) ranked highest (38.0 percent) labour inhibitor in the study area. This was followed by the seasonal migration (33.0 percent) of labour to the urban sector in search of the promising non-farm employment activities. The schooling of children (14.0 percent) was another problem followed by the

Table 3 Gender decomposition of labour-use (Mandays).

Production region	Adult male		Adult female		Children		Total	%
	No	%	No	%	No	%		
Oyo	39.34	65.22	11.27	18.68	9.70	0.16	60.31	100
Ogun	43.23	75.10	5.80	0.10	8.53	14.81	57.56	100
Osun	43.30	71.44	9.18	15.14	8.13	13.41	60.61	100
Ondo/Ekiti	36.25	64.06	9.66	17.07	10.67	18.85	56.58	100
All regions average	40.53	68.95	8.97	12.74	9.23	15.74	58.76	100

Computed from Field Data, 2009.

Table 4 Distribution of labour-use by specific activities (Mandays).

Production region	Understorey clearing		Agrochemical spraying		Harvesting		Fertilizer application		All	
	No	%	No	%	No	%	No	%	No	%
Oyo	30.61	22.79	51.64	38.45	36.7	27.33	15.32	11.40	134.27	100
Ogun	31.41	28.04	29.38	26.19	36.76	32.82	14.49	12.93	112.00	100
Osun	32.39	26.24	39.21	31.76	35.72	28.93	16.11	13.05	123.43	100
Ondo/Ekiti	31.39	24.59	45.87	35.94	36.37	28.50	13.98	0.95	127.61	100
All regions average	31.45	25.29	41.52	33.39	36.38	29.26	14.97	12.04	124.32	100

Computed from Field Data, 2009.

Table 5 Distribution of labour supply inhibitor in the producing zones.

Inhibitors	Frequency	Percentage
Labour Payment	76	38.0
Seasonal Migration	66	33.0
Schooling of Children	28	14.0
Non-availability of Adults	24	12.0
Improved non- Farm Income	6	3.0
Total	200	100.0

non-availability of adults to supply labour (12.0 percent) when mostly needed, and lastly improved non-farm income (3.0 percent).

3.2 Estimation of Labour-use Efficiency on Cocoa Farmers

3.2.1 Labour Requirement Frontier

Labour-use requirement frontier is defined as the minimum amount of labour that is technically necessary to produce a given level of output. The maximum likelihood estimate of the labour model parameters is presented in Table 6. The Cobb-Douglas labour-use frontier estimates shows that the labour-use requirement frontier is 0.76 for the sampled farmers. Hence, farmers employing labour above this production frontier are technically efficient in labour usage while those operating below the frontier are considered technically inefficient. Additional mandays of labour are still technically necessary to be utilized so as to be on the frontier. The quantity of harvested cocoa beans, size of cleared understoreys and quantity of applied agrochemicals significantly affected (at 5% level) the labour-use efficiency in cocoa plantations. Again, the estimate of the overall model variance of σ^2 (0.142) and γ (0.841) are significantly different from zero at 5 percent. This implies a good fit and the correctness of the specified distribution assumption.

Table 6 Parameter estimates of stochastic labour-use efficiency frontier model.

Variables	Parameters	full model	Restricted model
General labour-use model			
Constant	α_0	5.192 (-10.531)	-5.311 (-10.992)
Qty of cocoa beans harvested (kg)	α_1	2.580* (2.743)	0.628* (2.978)
Size of understorey farm cleared (m^2)	α_2	1.144* (3.709)	0.143* (3.729)
Qty of agrochemical sprayed (litre)	α_3	232* (11.047)	0.337* (11.326)
Qty of fertilizer applied (kg)	α_4	0.375 (1.508)	0.331 (1.463)
Labour-use inefficiency model			
Constant	β_{0j}	2.174 (1.508)	0
Age of the farmer (years)	β_{1j}	-0.754 (-1.489)	0
Farming experience (years)	β_{2j}	0.215 (1.111)	0
Level of education (years)	β_{3j}	0.013 (0.101)	0
Family size (ha)	β_{4j}	125 (1.769)	0
Farm distance traveled (km)	β_{5j}	-0.016 (-0.262)	0
Variance			
Sigma square	σ^2	0.142 (2.380)	0.164 (5.615)
Gamma	γ	0.841 (10.209)	0.845 (10.936)
Log likelihood function		-18.075	-20.978
LR test of the one sided error	λ LR	12.714	6.909
T.E. (mean)		0.747	

Computed from Field Data, 2009.
*Estimated significance at 0.05 level; Figures in parentheses are standard errors.

4. Conclusion and Recommendations

In this study, the researchers observed that the traditional family labour was not sufficient to meet their labour requirements for medium scale farming operations. This finding corroborates the earlier position expressed by Ref. [20]. Hence, sharecropper

labour remains the dominant labour type being used in cocoa production in South Western Nigeria. Adult male labour was in the majority (68.95%) and 80% of the farms were less than 5 hectares in size. The most popular farm labour revolved round cocoa harvesting and application of agochemicals. Again, it was noted that poor labour remunerations in terms of wages was a major constraint to farm labour supply for cocoa production in the study area. To enhance the fortune of the cocoa farmers, the following policy decisions should be put in place:

(1) There should be an increase in the farm wages so as to adequately compensate for the farm labour that were engaged on cocoa plantations. This, if done, will motivate other prospective workers to participate in farm operations;

(2) It was observed that the dominant farming operations in the study area were cocoa harvesting and application of agrochemicals. To fully achieve these tasks, young and dynamic farmers should be encouraged to participate in cocoa production. The cocoa rebirth programme of federal government should also be strengthened.

(3) The majority of the cocoa farms were noted to be less than 5 hectares in size. There should be an enabling environment that will encourage the participation of both the private and public sectors in cocoa production. If this is done, more credit facilities and farm labour will be made available to the cocoa farmers. At the end, the cocoa farmers will cover more land areas, their farm income levels will increase and their socio-economic life will improve.

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