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THE INFLUENCE OF TECHNOLOGICAL CHANGES ON LABOUR AVAILABILITY: A CASE STUDY OF COCOA FARMING HOUSEHOLDS IN OGUN STATE, NIGERIA

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ABSTRACT

In developing countries (such as Nigeria), labour is an essential factor in farming. This is because most of the farming activities are carried out with the use of labour. However, the advent of technological development has had an influence on labour availability. In view of the importance of labour in Nigerian agriculture, this study examined the effects of technological changes on labour availability. Primary data were collected using a structured questionnaire administered to a purposive sample of eighty cocoa farmers in Ogun state of Nigeria. Some of the information collected from the respondents includes the type of technologies adopted by the farmers, extent of labour used for different farming activities, farm size, farmer's income and labour's wage rate. The data collected were analysed using descriptive statistics, Analysis of Variance (ANOVA) and multi-variate regression analysis. Descriptive analysis revealed that some technologies such as improved spacing and fertilizer application require the employment of more labour while some technologies like mechanization and herbicide application displace labour. The result of the ANOVA shows that there was significant difference in the magnitude of labour used in different technological groups ($p<0.01$). Multi-variate regression analysis revealed that availability of labour is influenced by the extent of cultivation ($p<0.01$), expenditure on improved technologies ($p<0.01$), adoption of mechanization ($p<0.01$), adoption of herbicides application ($p<0.01$) and adoption of improved planting spacing ($p<0.05$).The study recommended that farmers should adopt improved technology practices (especially the ones that displace labour) to alleviate the problem of labour on their farms. Government should assist to make improved technologies available to farmers anytime they are needed and at subsidized prices. This will enable the farmers to adopt more improved technologies. Farmers should organize themselves into groups to enable them have access to credit facilities for them to be able to procure improved technologies. Small-scale processing industries should be established in the rural areas to take the advantage of the available excess rural labour resulting from the displacement by some technologies thereby eliminating the problem of unemployment that is likely to be generated as a result of the adoption of the technologies.

Key words: Influence, technologies, labour, cocoa, employment

INTRODUCTION

Nigerian agricultural sector is dominated by small-scale farmers whose farms vary between 0.10 and 5.99 hectares in size and constitute about 80.35% of all the 29,800 million farm holdings in Nigeria [1, 2]. Their farmers used traditional technologies called hoe-cutlass culture and their capital structure is in form of small tools and predominant usage of family labour [3]. Among the other problems that are associated with small-scale farming are the problems of low productivity due to the problems of pest and diseases infestation and the problems of aged crop trees (cocoa trees) [3]. Given the increasing population pressure and resultant increase in food demand, the government has found it imperative to find ways by which the agricultural sector could be improved. In line with this, a number of programmes have been embarked upon and some institutions have been established. Such institutions include the National Seed Service (NSS), National Accelerated Food Production Programme (NAFPP), Agricultural Development Project (ADP) and others. It should be noted that the main objective among others of these programmes revolve around the development and dissemination of improved technologies in farming practices.

Agricultural improved technologies are the various new "technical know-how" put in place to improve agricultural production. They alter the structure of agricultural production process through acting as a sure value for changing physical and value productivity of farm resources [4]. Some of these improved technologies are the use of tractors (mechanisation), application of fertilizers and insecticides, adoption of improved spacing, treatment of seed before planting, improved storage techniques and a host of others [5]. These have taken over from the use of traditional technology which is characterized with the problems of deterioration in the vigour and stability of human labour in an environment of high temperature and humidity [6].

In Nigerian agriculture, hired labour is predominantly used. In fact, it carries 88% of the total labour used on farms [7]. Apart from hired labour, the other types of labour that could be employed are family labour and cooperative labour. The availability of labour has been found to have impact on planting precision, better weed control, timely harvesting and crop processing [8]. Therefore, labour is a major constraint in peasant production especially during planting, weeding and harvesting [9].

However, there is a strange relationship between the technological changes and labour. The classical economists such as Ricardo, Malthus, Stuart Mill and Marx were particularly concerned with the problem of employment implications of technological change [6]. However, some authors believe that while some improved technologies such as improved planting spacing (reduction in planting spacing) increases the employment of labour, other improved technologies (such as machines and herbicides) by making production more efficient can lead to the reduction in the employment of labour.

In agricultural production especially during the on-season, there is always a persistent high demand for labour for most farm operations and this consequently leads to

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shortages of labour during the on-season [6]. Therefore, it is the focus of this study to determine the extent to which agricultural innovations have relieved the shortages of labour in farm operations and the indices generated in the study were used to proffer solutions to the problems of labour on farms. The study was undertaken through the following objectives: to investigate the pattern of adoption of improved technologies in the study area; to determine the magnitude of labour requirements by different improved technologies; to determine whether there is significant change in labour use among the different technological combinations; and to determine the factors that affect the availability of labour in the study area.

Hypothesis testing

H_0: $\bar{X}_1 = \bar{X}_2 = \bar{X}_3$. (There is no significant difference in the means of labour used among the different technological groupings).

H_1: $\bar{X}_1 \neq \bar{X}_2 \neq \bar{X}_3$. (There is significant difference in the means of labour used among the different technological groupings).

METHODOLOGY

The study was carried out in Ogun state of Nigeria. The state is one of the fourteen cocoa producing states in Nigeria [10]. Four cocoa producing Local Government Areas (LGAs) were chosen for the study. The LGAs are Abeokuta North, Abeokuta South, Odeda and Owode. Twenty respondents were purposively selected from each LGA making a total of eighty respondents in all for the study. This, however, represents 15% of the entire population of cocoa farmers in the study area.

Respondents were classified into three technological groups depending on the number of technologies adopted by the respondent. The technological groups are Low Technology (LT), Medum Technology (MT) and High Technology (HT). Low Technology is the adoption of a maximum of two technologies; Medium Technology is the adoption of between two and five technologies while High Technology is the adoption of more than five technologies [11]. Information was collected from the respondents with the aid of structured questionnaire and the data collected were analysed using descriptive statistics, Analysis of Variance (ANOVA) and multi-variate regression analysis. Descriptive statistics were used to analyse the pattern of adoption of technologies as well as the magnitude of labour requirements by different technologies. ANOVA was used to assess whether there is significant difference in the amount of labour used among the three technological groups. Multi-variate Regression analysis was used to evaluate the effects of the income of farmer, extent of cultivation, wage rate, expenditure on improved technologies, adoption of mechanization, adoption of herbicides application, adoption of insecticides application, adoption of improved seedlings as well as adoption of improved planting spacing on the availability of labour in the study area.

$\ln LAB = \ln\alpha_o + \alpha_1 \ln INC + \alpha_2 \ln EXT + \alpha_3 \ln WAG + \alpha_4 \ln EXP + \alpha_5 \ln MEC + \alpha_6 \ln HER + \alpha_7 \ln INS + \alpha_8 \ln IMP + \alpha_9 \ln SPA + e_i$

Where:

LAB = Availability of labour (Mandays);
INC = Income of farmers (N);
EXT = Extent of cultivation (Ha);
WAG = Wage rate (N);
EXP = Expenditure on improved technologies (N);
MEC = Adoption of mechanization (1, if adopted; 0, if otherwise);
HER = Adoption of herbicide applications (1, if adopted; 0, if otherwise);
INS = Adoption of insecticides application (1, if adopted; 0, if otherwise);
IMP = Adoption of improved seedlings (1, if adopted; 0, if otherwise);
SPA = Adoption of improved spacing (1, if adopted; 0, if otherwise);
e_i = Stochastic random error.

The *apriori* expectations for the variables are:
$\partial LAB/\partial INC$, $\partial LAB/\partial EXT$, $\partial LAB/\partial INS$, $\partial LAB/IMP$, $\partial LAB/\partial SPA > 0$; while
$\partial LAB/\partial WAG$, $\partial LAB/\partial MEC$, $\partial LAB/HER$, $\partial LAB/\partial EXP < 0$.

RESULTS

1. The following technologies were adopted by the farmers in the study area: Rehabilitation techniques, mechanization, improved seedlings, fertilizer, improved spacing, herbicides, insecticides and fungicides.

2. The labour requirements per hectare for different farm operations were: Manual clearing = 12 mandays; Mechanical clearing = 2 mandays; Herbicides application = 3 mandays; Planting with unimproved spacing = 5 mandays; Planting with improved spacing = 8 mandays; Fertilizer application = 6 mandays; Insecticides application = 3 mandays.

3. The result of Analysis of Variance (ANOVA) showed that there was significant difference in the amount of labour used in different technological groupings.

4. Regression analysis revealed that the following factors were determinants of labour availability in the study area (based on double-log regression result):
   Extent of cultivation ($P<0.01$);
   Expenditure on improved technologies ($P<0.01$);
   Adoption of mechanization ($P<0.01$);
   Adoption of herbicides application ($P<0.01$);
   Adoption of improved planting spacing ($P<0.05$).

DISCUSSION

Patterns of technological adoption by cocoa farmers

The improved technologies that have been introduced into the study area are rehabilitation techniques, mechanization, improved seedlings, fertilizer application, improved spacing, herbicides, insecticides and fungicides.

From Table 1, it could be observed that improved seedlings, fungicides as well as spacing are widely adopted in the study area. They have the proportion 80 percent, 81 percent and 79 percent of the total sampled farmers, respectively. This shows that the impact of extension personnel as regards the dissemination of information particularly on the improved technologies is greatly felt in the study area.

As for mechanization, herbicides and insecticides, these were marginally adopted in the study area by 3.8 percent, 16.0 percent and 19.0 percent of the total sampled farmers in the study areas, respectively.

Magnitude of labour requirements per hectare in different farm operations

Table 2 shows that some operations require more labour. Such operations include manual clearing, planting with improved spacing and fertilizer application, which require 12, 8 and 6 mandays, respectively. However, some operations such as mechanization, herbicide application and insecticide application require less labour (2, 3 and 3 mandays, respectively). Hence, some improved technologies such as spacing and fertilizer application add labour, while other improved technologies such as mechanization, herbicides and insecticides application reduce labour requirements. It should be noted that spacing increases labour due to the fact that most improved spacings are aimed at maximizing the use of land, thus bringing in more crop stands and more crop stands would definitely require more labour.

Variations in the quantity of labour used in different technological groupings

In order to determine whether there is significant difference in the number of mandays used in different technological groupings, the computer result of the analysis of variance in the labour used among the three technological groupings was used. The result showed that F calculated is 44.42. Meanwhile, F tabulated at 1% is 4.88. Since F calculated is greater than F tabulated, the null hypothesis [Ho] which states that there is no significant difference in the amount of labour used in the three technological groupings is rejected, while the alternative hypothesis [H_1] which states that there is significant difference in the amount of labour used in the three technological groupings is accepted. Therefore, there is significant difference in the amount of labour used among the three technological groupings. The differences might be due to the fact that some of the adopted improved technologies such as herbicide use displaced labour. However, some technologies such as fertilizer and improved spacing added labour but their impact might not be as high as those of labour-displacing improved technologies.

Determinants of the availability of labour

Multivariate regression analysis was used to determine the factors affecting the availability of labour and the result of the analysis is presented in Table 3. However, out of the three functional results, double log regression result was chosen based on the *apriori* expectation, value of the standard error, value of the coefficient of determination [R^2] and the number of variables that are significant. The result of the lead equation shows the R^2 of 69.7%, this means that the independent variables were able to explain 69.7% of the total variation in the dependent variable. Table 3 also revealed that out of the nine factors regressed against the dependent variable, five were found to significantly affect the availability of labour. These factors are extent of cultivation [$p<0.01$], expenditure on improved technologies [$p<0.01$], adoption of mechanization [$p<0.01$], adoption of herbicides application [$p<0.01$] as well as adoption of improved planting spacing [$p<0.05$]. The significance of the extent of cultivation could be attributed to the fact that size of farm determines the number of labour, that is, the larger the farm, the more the number of labour that would work on such a farm and *vice versa*. As for the expenditure on improved technologies, as more money is been spent on improved technologies, less labour would be employed since the improved technologies (such as herbicide use) would displace labour thus requiring less labour to be employed. Adoption of both the mechanization as well as the herbicide use requires less labour while the adoption of improved planting spacing would require more labour as most improved spacing aims at maximizing the use of land thus increases the planting density. It should also be noted in Table 3 that the signs of the significant variables conform to the *apriori* expectations of the variables.

CONCLUSION AND RECOMMENDATIONS

Based on the findings which revealed that much fewer mandays would be required to clear a piece of land by mechanization or herbicides when compared with manual clearing, the study concludes that the introduction of improved technologies (like mechanization and herbicide use) unequivocally reduce labour use. This will consequently reduce the stress of searching for farm labour especially during the on-season.

The study makes four key recommendations

First, farmers should try to adopt improved technology practices (especially the ones that displace labour) to alleviate the problem of labour shortages on their farms. Second, government should assist to make improved technologies available to farmers any time they are needed and at subsidized prices. This will enable the farmers to adopt more improved technologies. Third, farmers should organize themselves into groups to enable them have access to credit facilities for them to be able to procure improved technologies. Finally, small-scale processing industries should be established in the rural areas to take the advantage of the available excess rural labour resulting from the displacement by some improved technologies thereby eliminating the problem of unemployment that is likely to be generated as a result of the adoption of the improved technologies.

Table 1: Distribution of farmers by the technologies used

Technologies adopted	Number of farmers	Percentage
Rehabilitation techniques	36	45
Mechanization (mechanical clearing)	3	3.8
Improved seedlings	64	80
Fertilizer	40	50
Improved spacing	63	79
Herbicides	13	16
Insecticides	15	19
Fungicides	65	81

Source: Field survey (1)

Table 2: Labour requirements per hectare in different farm operations

Farm operations	Labour used (mandays)
Manual clearing	12
Mechanization (mechanical clearing)	2
Herbicides application	3
Planting with unimproved spacing	5
Planting with improved spacing	8
Fertilizer application	6
Insecticides application	3

Source: Field survey (2)

Table 3: Estimated regression coefficients for the determinants of the availability of labour

Variable	Coefficient	t-value
Income of farmers	0.0615	5.24
Extent of cultivation	1.1720	7.83***
Wage rate	0.0614	0.69
Expenditure on improved technologies	-0.3509	-4.38***
Adoption of mechanization	-0.1263	-3.71***
Adoption of herbicides application	-0.1152	-3.04***
Adoption of insecticides application	-0.0675	1.02
Adoption of improved seedlings	0.1072	1.38
Adoption of improved planting spacing	-0.0246	-2.43**
Constant	2.3051	6.01
R^2	0.697	
F	53.92	
Standard error	0.1382	

*** Significant at 1% level
** Significant at 5% level

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