EFFICIENT RESOURCE USE: DOES HUMAN CAPITAL MATTER? THE CASE OF CASSAVA PRODUCTION FARMERS IN OYO STATE, NIGERIA.

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Abstract
Sustained growth in productivity is closely associated with improvement in child nutrition, adult health, and schooling. In other words, investment in human capital is at a premium in rural development. We examined the role of human capital (HC)on farmer's resource use efficiency empirically (RUE). Population sample covered 6 local government areas in Oyo state from which 120 households were selected using multistage sampling technique. An index of human capital (HC) was developed using principal component analysis. Controlling for other covariates, the effect of human capital on resource use efficiency (RUE) was estimated using the frontier 4.1 package. Results showed that the mean HC for the population was 40% and ranged from 11% to 71% maximum. RUE scores ranged from 18.56 percent to 94.42 percent with a mean of 65.18 percent. The result suggests potential increase in cassava production by 54% through human capital improvement.

Keywords: Human capital, resource use, cassava production, Sustainable growth and rural development

1.0 Introduction

Efficient resource use by a farmer can be attributed to socio economic drivers amongst which are the farmer's knowledge base and the capacity to function. For programme and investment targeting, common measureable dimensions of human capital are schooling and health. Schooling can increase productivity by imparting specific knowledge and/or by enhancing skill in acquiring new knowledge (Rosenzweig, 2010). Health status on the other hand relates with productivity through the channel of capability and functioning (Strauss and Thomas, 1998). The link from human capital to productivity gains is well acknowledged by early classical economists. For example, Adam Smith noted that the more the people are instructed, the less likely they are to produce disorder and illiterate nations. Secondly the output of skilled human resources was found to add incrementally to the national product while investment on human resources increased the national product as well as national wealth. That is why Schultz (2003) argued that sustained growth in productivity is closely associated with improvements in a population's child nutrition, adult health, and schooling.

In the last decade, the United Nations Millennium Development Goals (MDGs) has been in the forefront supporting human capital development as well as other social services that promote the capability and functioning of individuals particularly for the rural poor. In 2001, Nigeria's government through the Ministry of Agriculture and Rural Development developed a National Policy on Integrated Rural Development (NPIRD). The priority areas and activities are shown in Table 1 below.

Table 1: National Policy on Integrated rural development in Nigeria (NPIRD)

PROGRAMMES PRIORITY AREAS	ACTIVITIES
PROMOTION OF RURAL PRODUCTIVE ACTIVITES	(1) Agriculture, Fisheries, Animal Husbandry And Forestry (2) Mineral Resources Development;(3) Manufacturing and Industry;(4) Marketing and Distribution;(5) Rural Financial Systems.
HUMANRE SOURCES DEVELOPMENT AND UTILIZATION	(1) Health and Population; (2) Culture and Social Development (3) Education, Technology and Skills Development;(4) Research and Extension Services; (5) Information and Communication.
ENABLING RURAL INFRASTRUCUTRE	(1) Transport infrastructure and facilities;(2) Communications infrastructure; (3) Housing, (4) Environment; (5) Energy; (6) Water and sanitation
TARGET GROUPS	(1) Women;(2) Youth; (3) Children; (4) The Elderly and Retired (5) Beggars and destitute; (6) Emergencies and National Disasters; (7) Economically Disadvantage Areas; (8) Border areas.
COMMUNITY ORGANISATION AND MOBILIZAION	Support of community initiatives.

Adapted from Okomadewa et al (2005)

NPIRD supports holistic development that includes agricultural productivity, social services provision like health centres, and schools. Also international development partners operating in the rural sector have committed a substantial amount of resources to this system. However given tight budget constraint of government and the trade-off between addressing short-term goals of poverty and smallholder productivity and long term goal of economic growth; strategies that maximize the contribution of social services to labour productivity in agriculture and the rural economy becomes an efficient possibility. (Wouterse, 2011).

The aim of this article was to examine the level of human capital amongst cassava farmers in the area as well as the effect on resource use efficiency. Although previous studies have looked at the role of human capital from the perspective of capability and entitlement analysis and also from the point of view of its role on agricultural productivity at the micro-level[1]. The inclusion of years of schooling or self-reported health measures, as a proxy of human capital is the common practice. While years of schooling, used in isolation, fall short of a good proxy for human capital, more appropriate measure that captures the multi-dimensional nature of human capital has not been explored. It is argued that if cassava-based farmers are not making efficient use of their resources for higher agricultural productivity, then efforts designed to improve efficiency through existing facilities in rural economy would be more cost effective. This article contributes by computing an index of human capital and examines its influence on resource use efficiency. Secondly the parametric approach which allows for the risky and climate dependent nature of agricultural production in Nigeria was applied.

2.0 Theoretical Framework

From the perspective of economics, "capital" refers to a factor of production used to create goods or services while "human" are the subject to take charge of all economic activities such as production, consumption, and transaction. Human capital means one of production elements, which can generate added values through inputting it (Dae-Bong, 2009). Awopegba, (2002) defines it as the knowledge, skills, attitudes, physical and managerial efforts required at manipulating capital, technology, land and material to produce goods and services for human consumption. Resource use efficiency (RUE) can be seen as a theoretical construct that can be recovered from the composite error term of the stochastic production function of an individual. In practice it reflects the relative level of a farmer's capacity to use production resources efficiently for productivity gains.

The views concerning human capitalas well as the various measures and limitation have been documented in Dae-Bong, (2009) presentation. There are those who conceptualize human capital as physical labour or something akin to property". There is the view that stresses on knowledge and skills obtained through compulsory education, postsecondary education, and vocational education. The production-oriented perspective views human capital as "an amalgam of factors such as education, experience, training, intelligence, energy, work habits, trustworthiness, and initiative that affect the value of a worker's marginal product. Various proxies of human capital have also evolved in time. For easy of analysis, it has been categorised into three approaches as shown in the table below.

[1] Adebayo (2006), Adeoti (2002), Ajani (2002), Ajibefun et al. (1996), Ajibefun and Abdulkadri (1999), Ajibefun and Daramola (2003), Amaza (2000), Awotide (2004), Ogundele (2003), Ogundele and Okoruwa (2006), Okike (2000), Oredipe (1998), Rahji (2003), and Udoh (2000).

Table 2: Conventional Human capital proxies

Conventional Approach	Indicators
Output based	School enrolment rates Educational attainment Skilled-adults to total adults ratio. Average years of schooling.
Cost-Based Approach	Costs invested for one's human capital including depreciation Discounted income in the future
Income-Based Approach:	Individual's income Productivity

These approaches are regarded as the conventional measures of human capital but have been found to be limited in a number of ways. First schooling rarely influences an individual's outcome; rather it is the non-schooling factors that appear to facilitate the effectiveness of schooling investment. Secondly, the conventional approaches slightly consider the qualitative benefits of family health, fertility and child morality. Thirdly, other indicators that can contribute to estimate more accurate concept of human capital are rarely considered. Based on this drawback, it has been argued in some quarters that since those factors that contribute to human development also relate with the variables of human capital, an appropriate proxy should partially accept the conceptual framework of Human Development index (HDI) that is multi-dimensional. Thus an appropriate proxy for human capital should encompass multi-output variables such as health status, years of schooling, adult literacy, social network, and trust. This corroborates with Schultz (1961) who identified five ways of developing human capital: Investment in health facilities and services; On-the-job training; formally organized education at the elementary, secondary and higher levels; Study programmes for adults that are organized by firms, including extension programmes notably in farm; and Migration of individuals and families.

In empirical studies, the role of human capital on development have been addressed as it relates to entitlement and capability function and also as it relates to technical or resource use efficiency. In all of these studies, the commonest proxies of human capital are years of schooling and health status. Educational attainment as a proxy of human capital takes into account the total amount of formal education received by the individual. Thus years of schooling are the most popular and most commonly used specification in the literature as well as school enrolment rates (Krueger and Lindahl, 2001). However, there is the drawback that an individual's years of schooling can be slightly related to his/her productivity. Secondly an individual's effectiveness can be recognized after participating in production activities. Thirdly it is difficult to clearly demonstrate this relationship, because educational attainment is often formal education. Human capital formation transcends formal education system. It is dynamic and multi-institutional, including the family, the educational system, formal and informal institutions, special professional and training organizations; enterprises in-house arrangements; as well as individual self-efforts and trainings (Adamu, 2002).

Health status on the other hand relates with productivity through the channel of capability and functioning (Strauss and Thomas, 1998). One of the measures of health status is self-reported health but it is fraught with controversy since health is a complex concept. Another major form of health status is the individual nutritional status. Nutrition as a form of human capital is often based on three anthropometric measures which are height for age, which measures "stunting", or chronic malnutrition; weight for age, a measure of underweight, and, weight for height, a measure of wasting or acute malnutrition. The body mass index (BMI) is the most common indicator of adult nutritional status. There are several limitations using these variables of health as proxies of human capital in a causal link with productivity. The first limitation is the problem of endogeneity. For example, while improved nutritional status and better health could lead to increased productivity, increased productivity also leads to higher incomes and consequently better nutritional and health status. The second type of endogeneity is that due to unobserved hetrogeneity. For example, an individual's ability could affect the demand for education while an individual's frailty could affect the demand for health inputs.(Schultz 2003). Third, like the case of years of schooling, there may be lags before a farm household member becomes more productive.

Wouterse (2011) studied the role of social services, human capital on technical efficiency of farmers in Burkina Faso. The study applies one of the approaches of measuring technical efficiency known as the Data Envelopment Analysis (DEA). A non-parametric approach which allows a flexible functional form. Specifically the study explored the role of human capital as measured by two separate proxies: years of schooling and nutritional status.

The data is panel and a two-stage estimation method within DEA is used for the analysis to allow for the endogeneity of human capital. Robust analysis was included using double-bootstrap procedure. Findings suggest that the impact of human capital on technical efficiency differs strongly by gender. Strong positive returns exist for education of females, whereas male education is associated with higher inefficiency. Body mass index of adult females also positively relates to technical efficiency. At the community level, presence of a clinic, connection to the electrical grid, presence of a secondary school, and year-round accessibility of the community are found to be vital for human capital formation. Foster and Rosenzweig (1996) used schooling as a proxy of human capital. They examined the role of schooling on agricultural profits using a structural estimation approach and an Indian panel dataat the household level on profits, input prices, capital assets and schooling for Indian farmers. The study also tested the hypothesis whether the returns to schooling rise when new technologies are promoted. Estimates suggested that farmers with a primary education exhibited higher profits than farmers without schooling. The positive association between schooling and technical change reflects the contribution of schooling to facilitating the acquisition of new knowledge about the technologies that was introduced since primary-educated farmers did not learn anything about the new seeds when they were in school.

Behrman et al.(1999) examined the effects of a mother's schooling on the efficiency of children's human capital accumulation. The use of mother's schooling is based on the notion that mother's schooling complements the production of human capital of children. They used a model of schooling investment that incorporated productivity effects of maternal schooling, Bargaining power effects of maternal schooling and marriage market selection. They used the panel data for India to first of all establish that rural women did not participate in the paid labor market and women's schooling, unlike men's schooling, had no significant effect on farm profits whether or not farms used the high-yielding seeds associated with the green revolution. They showed, however, that the demand for literate wives increased more in areas of India where technological change in agriculture was highest. They also showed that, within extended households, sons of mothers who were literate studied more hours than sons of illiterate mothers. They thus conclude that there are increases in the nonmarket returns to schooling for women that parallel the returns to schooling in the market sector.

Duflo et al. (2008) carried out a field experiment in Kenya randomly subsidizing a pre- specified dosage of fertilizer, and then estimated returns from fertilizer variation. They found that neither more educated farmers nor farmers with previous experience with fertilizer obtained higher profits from increased fertilizer use compared with their less educated or experienced counterparts.Consistent with both the experimental and non-experimental findings within agriculture, a recent field experiment (Dupas, 2009) that randomly assigned different prices for new, improved bed nets obtained findings showing the combined presence of social learning and schooling effects on adoption. In particular, take-up rates were greater among the more educated and respondents who had neighbors receiving the lowest prices were more likely to adopt and keep the new nets, given the prices they faced. From these reviews, though schooling is important for productivity there are other factors acting such that schooling may be more or less important in various places and times and the aspect of schooling is also of importance.

3.0 Conceptual framework

Resource use efficiency is a relative concept defined as the ratio of the actual production of cassava in a given farm to the best practice frontier productions0. A famer's actual production can lie on the best practice frontier or below it. Deviation from the best practice frontier productions is attributable to the composite error term defined as random noise (V) and technical inefficiency (U).They are additive and also independently and identically distributed. The independent assumption allows us to disentangle U from V, U being the key parameter of interest. The parameter is not directly observable what is observable is the probability or expected value of U conditional on the value of $\varepsilon_i = V_i - U_i$, that is$E\left(U_i|\varepsilon_i\right)$. The indicator ranges between zero and 1 where 1 represents achievement of the best practice frontier production adjusted for random noise (V) for the given resources. This parameter is used to define a resource use situation that allows observed cassava productions to move away from the best practice frontier production. It is hypothesize that human capital reduces this situation and therefore leads to increased productivity and income of cassava based farmers. The pathways for this to happen include schooling, health status, age, and social network. Schooling may enhance resource use efficiency directly by improving the quality of labour and managerial skills. Thus it is expected that the ability of farmers to adjust to disequilibria, would increase with the consequential effect on input utilization. Farmers who are frail could experience lower technical efficiency due to impaired work capacity in the field and reduced management and supervision abilities. Farmers who do not interact may learn less of how to use new technologies and less of adoption of improved technologies. These characteristics of farm household members are viewed as components of human capital because they can be increased by social or private investments, but they also vary across individuals because of genetic and environmental factors that are not controlled by the individual, family, or community (Schultz 2003).

There are two common approaches in the literature for estimating resource use efficiency at the micro level. One approach is based on non-parametric or non-stochastic or linear programming (data envelopment analysis DEA). This approach suffers from the criticism that it takes no account of the possible influences of measurement error and other noise in the data (Coelli, 1995). The second is the parametric approach, which uses econometrics to estimate a stochastic production frontier function. The disadvantage of this approach is that it imposes an explicit and possible restrictive functional form on the technology. However in most studies cob-douglas functional form is used because of its simplicity. Furthermore in estimating how various factors influence efficiency two approaches are common in literature. The first is the two- step procedure in which the frontier production function is first estimated to determine technical efficiency indicators and in the second stage, the derived inefficiency indicators are regressed against the various factors thought to influence it using the Tobit model. Some authors have noted the inconsistency in the efficiency effects when two independent and separate regressions are performed because it violates the assumption that the error term is identically distributed. (Squires et al., 2003; Ogundele, 2003). Simar and Wilson (2007) emphasized the error term will be serially correlated and standard inference not valid. Secondly, efficiency scores are likely to be biased in finite samples. The second approach allows all the parameters to be estimated in one step using maximum likelihood procedure and therefore likely to give more consistent efficiency effects.

4.0 Materials and Methods

4.1 Study area

The area of study is Oyo state, located in the South-western geopolitical zone of Nigeria. The choice is based on convenience and the prevalence of cassava growers. It covers a land area of 27, 000sqKm and has 33 local Government areas, and three senatorial district namely Oyo central, South and Oyo North. There are two district seasons namely wet and dry seasons and the rainfall pattern ranges between 1,211mm and 1,264mm. Primary and secondary sources of data were gathered. The Primary Data were collected from with the aid of structured questionnaire administered to cassava-based farmers in 2010. Secondary information was drawn from various past studies on human capital and technical efficiency. A stratified sampling procedure was adopted. In the first stage, the state was stratified into three senatorial districts and two LGAs were selected from each senatorial district. Oyo central (Oyo west and Atiba); Oyo south (Iddo and Ibadan North), and Oyo North (Ogbomosho South and Ogbomosho North). A total of six local government areas were picked from the state while 30 households were randomly picked from each of the local government area making the total household sample size 180. Only 120 questionnaires were appropriately filled and returned.

4.2 Analytical tools.

4.2.1 Computation of Human Capital Index

Indexing technique is the commonest approach for aggregating interrelated indicators into a single value for policy use or further analysis. The use of principal component analysis is often motivated by a concern for the so-called problem of double counting. Each indicator is normalized by its mean and standard deviation across households. Once normalized, PCA finds the linear combination of the indicators with maximum variance, usually the first principal component. The HCI index is computed for a sample of 120 cassava-based farmers. The computation implicitly assumes that farmers are linearly sorted according to the summarized performance of the indicators included. The weights are directly derived from the original data set and vary across the sample population allowing for heterogeneity. The HCI values derived ranges between 0 and 1 with one reflecting the maximum possible human capital and zero null human capital.

4.2.2 Efficiency and human capital interaction estimation

USE: Two things were done. First a stochastic production function was estimated using the empirical model expressed as;

$$lnY_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 lnX_{2i} + \beta_{3i} lnX_{3i} + \beta_{4i} lnX_{4i} + V_i - U_i \quad (2)$$

Where:

Y = total output (tonnes).

X_1 = Farm size (ha)

X_2 = Amount spent on hired labour)(₦)

X_3 = Family labour (Hours)

X_4 = Capital (₦)

$V_i = Noise$

$U_i = Inefficiency\ of the\ ith\ farmer$

Second the influence of human capital on resource use efficiency was considered in the inefficiency function U_i.

$$U_i = \delta_0 + \delta_1 hcapital_i + \delta Z_i \quad (3)$$

Where;

hcapital is human capital

Z_i are the socio-economic characteristic such as age, gender and farming experience, of cassava producers in the area. The derived inefficiency value of each farmer is related to factors hypothesize to influence it including the human capital index of the farmer.

5.0 Results and discussion

5.1 Descriptive Analysis

The average sample farm size as shown in table 1 is 3.94ha and it is consistent with the average farm size of smallholder farmers in Nigeria which ranges between 2- 5 hectares. The average labour used is 921.5 man-days which indicates that cassava production in the area is labour intensive. While the average years of farming experience is 20 years, resource use efficiency across the population spreads from left to right with the mean value being 0.6518. The levels of education are primary and secondary representing 48.3% and 33.3% respectively. Male farmers are disproportionately more than female farmers representing 79.2% and 20.8% respectively. While 91.7% of the farmers have spouses farming operation is largely on full time basis (94.2%). Other less visible occupation includes trading (1.7%)and teaching (3.3). 70.8% of farmers had attended one training or the other on cassava farming business implying some appreciable farming skills. Little wonder 89.2% of the respondents had at least one extension contact on cassava farming business. 77.5% of the farmers assessed their health status as good, 11.7% average health and 10% excellent health.

Notwithstanding 90% of the respondents claimed they had fallen sick occasionally while those who fell sick monthly, weekly and fortnightly represented 5.8%, 0.8% and 0.8% respectively. 65% visited the hospital only on occasional basis while 10.8% and 24.2% on a regular and seldom basis respectively. 65% had access to health care service in their neighbourhood while 35percent had no access. Hired Labour predominant (85%) as against 15% using family labour. Lease arrangement is the commonest way of acquiring land (55%) while free hold communal system represented 37.5%. 65.8% had access to credit facilities while 34.2percent do not have access to credit. 58.3% got credit from commercial bank/Cooperative societies. Others through Neighbours, Money lenders and some unspecified means representing 5.8%, 0.8% and 1.7% of farmers respectively. 33percent did not request for any credit facilities. Majority of the farmers (29.1%) use credit ranging between N40, 000-N80, 000. 73.3% of the respondents acquire their cassava stems through purchase while 19.2percent got it from their own farms. Fertilizer input is rarely used but chemical weed control is used accounting for 78.3% of the farmers. The following chemical weed controls were used: Glyphosate (33.3%) and Gramozone (21.7%), unspecified weed control (21.7%). The use of Pesticides is a little less than chemical weed control (47.5%). Pesticides used include Cypermethrin(25) and unspecified pesticides (22.5%) The implication of this is that majority of the farmers do not recognize the importance of pesticide application for their cassava production.The mean human capital index (HCI) of the farmers is 0.38603. This appears low and expected to reduce efficient use of resources. Surprisingly the HCI of male cassava farmers is (0.4042) greater than that of the female cassava farmers (0.3199).

5.2 Resource use efficiency and human capital capacity interaction estimation.

Resource use efficiency capacity generated from the stochastic production frontier indicates a wide variation across the farms. The minimum capacity is 18% while the maximum is 94%. The fact that the resource use capacity of all the sampled cassava farmers is less than one means that none of them reached the frontier threshold. However, the mean capacity is estimated at 65% meaning that 54% $[(100)82)/82]^2$ of production is lost because of inefficiency in resource use. This implies that the average farm producing cassava have the potential to increase production by 54% by improving resource use efficiency The table presents the results of the stochastic production frontier model. The estimated parameters along with their corresponding standard errors and t values are reported. Also reported are the variance parameters, derivatives from the variance parameters and log-likelihood ratio test. The test statistics of the likelihood ratio is 48.83 indicating that the empirical specification of the inefficiency function is appropriate. That is the hypothesis that the effects of the exogenous determinants on production efficiency function at the sample mean approximation are statistically equal to zero ($H0$: $\alpha = 0$) is rejected. The high Gamma(γ) value of 0.89 also supports the structural appropriateness of the model specification since it defines the total variation of output from the frontier. That is the included inputs together explain the variation of the observed output from the frontier. The sigma squared(σ^2) 0.18 is statistically significant and indicate the goodness of fit and correctness of the distributional form assumed for the composite error term. This study assumes the exponential functional form. The variables shown in the table are all significantly different from zero at the 5% level. Also ranges between one and zero and all are positive. From Table 2, land is themost important factor of production, having an elasticity of 0.6646. This implies that 10% increase in ha of land used would increase the total output by 66%. This result agrees with the findings of Eyoh and Igben (2002).Another factor of production is labour, having an elasticity of 0.3270.This is consistent with the observation that production of crop-mix in the study area is labour intensive. Therefore an increase in mandays by 1%increases total farm output by 33%. Capital input is a significant determinant of production in the study area. Thus, it has the elasticity of 0.2778. This

[2]See Raham (2011)

implies that 1% increase in capital input used in cassava production in the study area would increase the total output by 28%.The estimated coefficients of the inefficiency function provide some explanation for the relative resource use efficiency capacity among individual farms. All parameter estimates were statistically significant at the 1% significance level except for age and gender. Human capital capacity relates with RUE in a positive direction such that increasing HCC per farmers will increase RUE of the farmer. This relationship is significant ($p<0.01$). Furthermore, the scale co-efficient is 1.27 signifying increasing returns to scale of cassava production. Age have a negative relationship with the technical efficiency.

6.0 Conclusion

Cassava is the most important food staple in Nigeria and once a neglected crop in some places is fast becoming an elite food crop in sub-Sahara Africa (Philips, et al .2004). Nigeria is known to be the leading producer of cassava globally, harvesting from 3.81 million ha, it produced 45.72 million tonnes in 2006, 18% higher than its production in 2004. This increase in production came about as a result of the interventions of the Nigerian Government and some developmental agencies. (Sanni et al, 2009). Economic importance stems from the wide use as food (tuberous roots), industrial materials, feed input for animals and source of employment and income to farmers, processors and Nigeria: starch, chips, gari and highly quality cassava flour (HQCF) future are common. Cassava also find uses in other industries apart from HQCF being used in the food industries, especially feed and non-food industries, including starch for manufacture of textiles, paints, adhesives, and other chemicals. The study determined the effect of human capital on resource use efficiency of cassava-based farmers using the adapted UNDP, (1998) Human Development Index (HDI) to compute the individual farmer's human Capital Index (HCI) and also stochastic parametric estimation techniques were also used. It is argued that if cassava-based farmers are not making efficient use of their resources for higher agricultural productivity, then efforts designed to improve efficiency through existing facilities in rural economy would be more cost effective. The distribution of resource efficiency revealed a rather wide variation of efficiency index across the cassava farmers, showing a maximum value of 0.95 and a minimum value 0.19. The overall mean technical efficiency of 65% reflects the possibility to increase cassava production by 54% if the representative farmer's RUE is improved upon. The positive relationship between human capital index variable and technical efficiency of the farmers implies that policies that will increase human capital accumulation of the cassava farmers especially the human capital index (HCI) indicators from government and non-governmental agencies will go a long way in addressing their resource use inefficiency problems

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Table 3: Summary of variables used

VARIABLES	MEAN	MINIMUM	MAXIMUM
Marital status	0.91	0	1
Age(years)	44.73	22	72
Gender	2	0	1
Years of schooling	2	1	6
Extension contact	0.89	0	1
Farm size	3.94	0.5	21
Health care status	0.66	0	1
Labour (man days)	921.63	52	4680
Capital (N)	5559.21	917	25000
Hours of labour/day	6.13	3	9
Household size(No.)	5.5	1	12
Training	0.71	0	1
Expenses on labour/day	1371.67	200	6000
Apply pesticide	0.52	0	1
Apply chemical weed control	0.81	0	1
Number of hired labour	3.62	0	11
Number of family labour	0.73	0	15
How many days worked per week	4.99	0.5	10
Distance to farm (km)	6.62	0.1	65
Quantity of harvest(tones)	9.23	0.35	100
Farming experience	20.17	3	54
Cost of cutlass	2508.54	225	12500
Cost of hoe	1885.94	250	12500
Cost of knapsack sprayer	722.63	0	9000
N	120		

Source: underlying data from field survey 2010

Table 4: Stochastic production and inefficiency estimates

VARIABLES	COEFFICIENTS	STANDARD ERROR	T-VALUE
Constant term	-1.3536	0.6296	-2.1498
Labour	0.3270	0.1441	2.2701*
Capital	0.2778	0.1118	2.4842*
Land	0.6646	0.1264	5.2595*
Constant	-0.7692	0.6597	1.1661
HCC	1.8323	0.9088	2.0162*
Gender	-0.0004	0.1914	-0.0018
Age	-0.0112	0.0101	0.0111
Farming experience	0.0261	0.0542	3.4109*
Diagnostic statistics			
Sigma-square	0.1850	0.0542	3.4109
Gamma	0.8892	0.0645	13.7854
Ln(likelihood)	-32.20		
LR test	48.83		
No. of observations	120		

Table 5: Descriptive statistics

Educational Qualification	**Frequency**	**Percentage**
Primary School	40	33.3
Secondary School	58	48.3
Others	22	19.4
Gender	Frequency	Percent
Male	95	79.2
Female	25	20.8
Marital Status	**Frequency**	**Percent**
Single	10	8.3
Married	110	91.7
Major Occupation	**Frequency**	**Percent**
Farming	113	94.2
Others	7	5.8
Training	**Frequency**	**Percent**
No	35	29.2
Yes	85	70.8
Extension Contact	**Frequency**	**Percent**
Yes	107	89.2
No	13	10.8
Health Status	**Frequency**	**Percent**
Average	15	12.5
Good	93	77.5
Excellent	12	10
Incidence of Illness	**Frequency**	**Percent**
Occasionally	108	90
Others	11	10
Hospital visit	**Frequency**	**Percent**
Occasionally	78	65.0
Regularly	13	10.8
Seldom	29	24.2
Access to Healthcare service	Frequency	Percent
No	42	35.0
Yes	78	65.0
Type of labour	**Frequency**	**Percent**
Family Labour	18	15
Hired Labour	102	85
Access to Loan	**Frequency**	**Percent**
No	41	34.2
Yes	79	65.8

Source: underlying data from field survey 2010

Table 6: Human capital index estimates

Farmer s/n	HCI	Farmer s/n	HCI	Farmer s/n	HCI	Farmer s/n	HCI
1	0.324561	31	0.39101	61	0.408626	91	0.458993
2	0.360163	32	0.380098	62	0.320494	92	0.440973
3	0.136016	33	0.462241	63	0.350405	93	0.437836
4	0.292798	34	0.40127	64	0.350918	94	0.274364
5	0.265426	35	0.500965	65	0.331791	95	0.323973
6	0.227342	36	0.333242	66	0.360674	96	0.37147
7	0.38267	37	0.362553	67	0.284909	97	0.332745
8	0.418397	38	0.450914	68	0.295179	98	0.438008
9	0.418397	39	0.331768	69	0.404935	99	0.438008
10	0.489685	40	0.342038	70	0.468478	100	0.448303
11	0.443346	41	0.245547	71	0.483882	101	0.448303
12	0.451365	42	0.320416	72	0.312281	102	0.399774
13	0.342036	43	0.320416	73	0.396364	103	0.42609
14	0.271213	44	0.367912	74	0.406633	104	0.508675
15	0.368132	45	0.344677	75	0.39742	105	0.462726
16	0.437892	46	0.373047	76	0.39742	106	0.386358
17	0.469977	47	0.346731	77	0.381374	107	0.444272
18	0.11333	48	0.373047	78	0.343879	108	0.454541
19	0.232072	49	0.373047	79	0.39651	109	0.444418
20	0.26609	50	0.373047	80	0.401645	110	0.449553
21	0.321075	51	0.350839	81	0.436733	111	0.449553
22	0.342898	52	0.383317	82	0.410417	112	0.495204
23	0.45137	53	0.383317	83	0.441868	113	0.495204
24	0.3016	54	0.383317	84	0.350536	114	0.446701
25	0.30018	55	0.313141	85	0.379432	115	0.482694
26	0.312504	56	0.323411	86	0.387147	116	0.380947
27	0.34822	57	0.438944	87	0.394862	117	0.406621
28	0.353355	58	0.438944	88	0.415401	118	0.53301
29	0.353355	59	0.416705	89	0.415401	119	0.569567
30	0.354895	60	0.398331	90	0.458993	120	0.715447

Source: underlying data from field survey 2010