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Effects of social capital on technical efficiency of cassava production in Oyo State, Nigeria

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ABSTRACT

This paper evaluates the effects of social capital available in Innovation Platforms on the technical efficiency of cassava production in Humidtropics field sites in Oyo State, Nigeria. Multistage sampling procedure was used to select 100 respondents, comprising of 41 platform members and 59 non-members in the sites. Data were collected with the aid of pre-tested structured questionnaire on socio-economic characteristics, farm size, forms of social capital network as well as quantities of inputs and outputs. Data were analysed using descriptive statistics, stochastic frontier function and Tobit regression model. The results of the study revealed that the technical efficiency of the farmers are high and membership in the Innovation platform increased the technical efficiency of cassava production. It was recommended that policies should be directed towards the creation of social capital networks through the establishment of Innovation platforms in order to increase the technical efficiency to boost cassava production for food security and better livelihood.

Key words: Cassava, social capital, Innovation Platform, Nigeria, technical efficiency

RÉSUMÉ

Le présent article évalue les effets du capital social des plateformes d'innovation sur l'efficacité technique de la production de manioc dans les milieux humides tropicaux de l'État d'Oyo, au Nigeria. Un dispositif d'échantillonnage à plusieurs niveaux, a été utilisé pour sélectionner 100 personnes, dont 41 membres des plateformes et 59 autres n'appartenant pas aux plateformes. Les données sur les caractéristiques socio-économiques, la taille de l'exploitation agricole, les formes de réseau de capital social ainsi que les quantités d'intrants et de produits ont été collectées à l'aide de questionnaire structuré pré-testé. Les données ont été ensuite analysées à l'aide des statistiques descriptives, des fonctions stochastiques et des modèles de régression Tobit. Les résultats ont révélé que l'efficacité technique des agriculteurs était élevée et que l'appartenance à la plate-forme Innovation augmentait l'efficacité technique de la production de manioc. Il a été recommandé que des politiques soient orientées vers la création de réseaux de capital social à travers des plateformes d'innovation pour accroître l'efficacité technique et stimuler la production de manioc pour une sécurité alimentaire et l'amélioration des conditions de vie.

Mots-clés: manioc, capital social, plateforme d'innovation, Nigéria, efficacité technique

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is one of the most important food sources in tropical countries, with over 500 million people consuming it as their main source of calories (IITA, 2011). In Nigeria, the role of cassava is not limited to food, as it also serves as cash crop, while its derivatives are applicable in

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many types of products such as confectioneries, monosodium glutamate, drugs, and chips, amongst others (Aerni, 2005). As an energy derivative, cassava has been shown by the United State Department of Agriculture (2014) to be more efficient in the production of fuel than most crops used as bio-fuel. Cassava tubers and hay are used worldwide as good roughage source for ruminants such as dairy or beef cattle, buffalo, goats, and sheep. It is also used in a number of commercially available laundry products, especially as starch for shirts and other garments. This multidimensional importance has made cassava farming a choice of enterprise to the resource-poor rural households.

Cassava farming is described as the most productive enterprise with highest net margin in most parts of Nigeria, thus making its cultivation practices common among poor rural smallholder farmers (Fakayode *et al.,* 2008). Cassava production has been identified to be constrained by a wide range of technical, institutional and socio-economic factors (Manyong *et al.,* 2005). These include pests and diseases, agronomic problems, land degradation, shortage of planting materials, access to markets, limited processing options, ineffective extension delivery systems and lack of institutionalized form of social capital which is available in rich stock in the rural communities. Due to these constraints, Nigerian farmers having a yield estimate of 11 tonnes per hectare are unable to complete with its counterpart in some other countries such as India, which has a yield estimate of 34.8 tonnes per hectare (FAOSTAT 2015). Problems arising from policy and lack of organizational structure for multi-stakeholders process in food production, hinders the accessibility to input, farm credits, extension services, distribution of produce and the participation of smallholder farmers in agricultural and rural development activities that would otherwise lead to formation of social capital for efficient increase in cassava production (Manyong *et al.,* 2005; Agboola, 2014).

Social capital is an intangible livelihood assset in cassava production, that plays a key role in the development of the agricultural sector. It represents the entirety of social relations, network of resources which is legitimized by the family, group, class or platform membership (Bourdieu, 1986) and that allow access to material and immaterial resources, information and knowledge through research and extension (Gretzinger *et al.,* 2010). Social capital exists in any network where people share information and resources, and requires its individual owner's outcomes (such as production efficiency) for its explanation and measurement in the network. Social capital when institutionalized, as commonly found in various rural development programmes, requires a bulk of efforts for its creation and maintenance to generate a desired outcome through the bonding, bridging and linking network avenues made available by such programmes using multi-stakeholder approach for the development of rural communities (Pretty, 2003; Bonnewitz, 2005; Gomez-Limon *et al.,* 2012). Also, its outcomes are specific to nature and objective of each network created thus requires creativity and diligence to measure (Glaeser *et al.,* 2001; Sander and Lee, 2014). Social capital can increase welfare by reducing the transaction cost due to social network built to access credit, input and relevant information that will lower the risk of income fluctuation and inefficiency in cassava production (Coleman, 1988; Narayan and Pritchet, 1997; Yusuf, 2008; Adepoju and Oni, 2012).

Several programmes and policies have been put in place to address these challenges of production inefficiency arising from lack of social capital network of stakeholders in cassava sub sector. These include The Presidential Initiative on production of cassava, which centered its activities on the development of production, processing, and marketing of the processed products within the programme timeline between 2002 to 2007 (IITA, 2009). Most of the stakeholders were made to play a role in this programme independently, however, this could not create sufficient and sustainable social capital network needed for efficient cassava production especially in the humid tropics and sub tropical zone. Hence, there is a need for a programme such as Humidtropics that connects all the stakeholders together in Innovation Platforms.

Humidtropics programme is a Consultative Group on International Agricultural Research (CGIAR) initiative that aims at helping poor farm families in the tropical region, strengthening research and stimulating institutional innovation that can increase economic and social returns among rural households who adopt enhanced and sustained agricultural production and marketing strategies, through establishment of Innovation Platforms. Innovation Platforms formed by the programme have been in operation for several years (RAAIS, 2014). The specific stakeholders within this platform includes rural farmers, input dealers, farm labourers, transporters, farm produce processors and marketers, extension agents, financial institutions, researchers, government agencies (local authorities and the ministry of agriculture), Non-governmental organisations and the research institutes, both the internal and external partners, which are the key players surrounding the crop production using participatory approach at all level of activities. The Innovation Platforms (IPs) are aimed at building and strengthening the social capital networks in agricultural production systems in Nigeria with the involvement of farmers in the programme. Understanding the effects of social capital on the efficiency of cassava production among farmers in the Humidtropics programme, therefore, becomes imperative, which is the basis of this study. This study describes the socio economic characteristics of cassava farmers and determines their technical efficiency by examining the effects of social capital on the efficiency of cassava production in Oyo State, Nigeria.

MATERIALS AND METHODOLOGY

Study area. This study was carried out in Oyo State, Nigeria. The state lies between latitude 6^{o}N and longitude 4^{o}E of the Greenwich Meridian with annual temperatures of 26.2^{o}C and a mean annual rainfall of 1247mm. The main occupation of the inhabitants is farming. The type of crops cultivated in the study area are yams, cassava, groundnuts, maize, beans, pepper, soya beans and vegetables. Humidtropics programme has two field sites located in Ogo Oluwa local government area and Ido local government area in Oyo State. The field sites were selected by the programme based on high poverty level, low market access and high susceptibility to natural resource degradation, and there is an established Innovation Platform (IP) in each of the field sites in Oyo State (RAAIS, 2014).

Data collection. The data used for this study were obtained from a cross sectional survey of farmers located in the Humidtropics programme sites in Oyo State, Nigeria, which include the Ogo – Oluwa field site and Ido field sites where Innovation Platforms (IPs) have been established. The data were collected using a pre-tested, well-structured questionnaire on socio- economic characteristics, forms of social capital, quantity and prices of input and output of cassava production.

Sampling procedure and sample size. A multistage sampling technique was employed. The first stage was a purposive selection of two Local Government Areas where the Humidtropics IPs had been established. The second stage was a random selection of five villages in each of the LGAs . The third stage involved a random selection of 30 members and 30 non-members of the Humidtropics IP cassava farmers in the village making a sample size of 120 respondents. Members and non-members belonged to the same LGAs. Only 100 responses comprising of 41 members and 59 non-members who participated in the interviews were considered for the analysis.

Analytical technique. Descriptive statistics were used to describe socio-economic features of the respondents and forms of social capital in the study area. These include mean, percentage and frequency distribution. Stochastic production frontier function was used to determine the technical efficiency of cassava production and Tobit regression was used to evaluate the effects of social capital on the efficiency of cassava production in the study area.

Stochastic frontier model specification. The major tool of analysis used in this study was the stochastic frontier model by Battese and Coelli (1995), In order to determine the technical efficiency of cassava production in the study area. The general stochastic frontier production function model was specified in the implicit form as:

$$Yi = f\,(Xi,\beta) + (Vi - Ui) \qquad (1)$$

Where Yi is the output of the i^{th} farm, Xi is a k x l vector of input quantities of the i^{th} farm, β is a vector of unknown parameters to be estimated, Vi is random error which is independent of the Ui, Ui is non-negative random variables called technical inefficiency (Aigner *et al.,* 1977). A Cobb-Douglas production form of the frontier for this study is as follows:

$$lnY = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + (V_i - U_i) \qquad (2)$$

Where Y = Cassava Output (kg), X_1 = Farm size (ha), X_2 = Total labour (Mandays), X_3 = Fertilizer (kg), X_4 = Herbicide (litre), X_5 = Planting materials (kg), β_0, β_1, …, β_5, = estimated parameters.

Tobit regression analysis. The Tobit regression analysis was used to determine the effect of social capital on efficiency of cassava production. The efficiency was generated in the stochastic frontier estimation and the social capital according to literature (Glaeser *et al.,* 2001; Harper, 2002; Sander and Lee, 2014). Thus, an holistic measurement of social capital in innovation platform considered the groups and networks aspect in this study. This was measured by indicators such as membership in formal or informal organization or association, ability to get support from those other than family members and relatives, in case of hardship, ability to learn from one's network or group, access to various markets (labour, input, or output) via the group (Narayan and Cassidy, 2001; Roslan *et al.,* 2010; Balogun and Yusuf, 2011; Foxton and Jones, 2011).

Therefore, the Tobit regression model that was employed was written as follows:

$$E = f\,(SCi) \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where E = Efficiency, SCi = Social capital indicators ($I_1 - I_{10}$)
Explicitly:

$$E = \alpha_0 + \alpha_1 I_1 + \alpha_2 I_2 + \alpha_3 I_3 + \alpha_4 I_4 + \alpha_5 I_5 + \alpha_6 I_6 + \alpha_7 I_7 + \alpha_8 I_8 + \alpha_9 I_9 + \mu \qquad \ldots\ldots\ldots (4)$$

Social capital indicators are specified as follows: I_1= Contact with research institutions (0= No, 1=Yes), I_2= Number of social organization of farmer (#), I_3= Number of extension visit (#), I_4= Decision making in the family on farming (0= No, 1=Yes), I_5= Farming experience (years), I_6 = Educational level (years), I_7 = Age (years), I_8 = Household size (#), I_9= Sex (0 =Female, 1 = Male), 0, 1… 9 are the parameters to be estimated.

RESULT AND DISCUSSION

Socio-economic distribution and social capita indices of cassava farmers. The distribution of respondents according to their socio-economic characteristics and the identified form of social capital network of farmers in the Innovation Platforms (IPs) established in Humidtropics programme sites in Oyo State are shown in Table 1. The percentage of male farmers was lower among the IP members (56.1%) compared to non-member (74.6%). The lower number of male among the members indicates that the Humidtropics IPs were, at some extent, gender balanced, there was likely to be some incentives to encourage more female farmers to participate in the activities of the platforms in order to improve their livelihood. The t-test showed that there was no significant difference in mean values of other socio-economic variables such as age, household size, years of education and years of farming experience among the IP members and non-members.

The result of the social capital indices on the other hand, showed that the form of social capital network available in the programme sites included membership in social organization, contact with research institution, extension visits, and decision making in the family on farming activities. The result indicated that majority (95.1%) of members had contacted the research institutions while only few (6.8%) non-members had contact with research institution. This suggests that members of Humidtropics IPs by virtue of their participation in the platform activities enjoyed more contacts with research institution as one of the major stakeholder in the platform. Also, there was a significant difference ($p<0.1$) in mean number of extension visit among IP members (3.34) and non members (1.61). This implies that there were more extension visits to cassava farmers who belonged to the Humidtropics IPs than the non-members, as the extension services are required to follow-up on the innovative and improved practices among their contact farmers in order ensure their adequate use.

Technical efficiency of cassava production. The maximum likelihood estimates for the Cobb-Douglas stochastic frontier model for cassava production efficiency were obtained using Frontier 4.1. The stochastic frontier model and the inefficiency model were estimated simultaneously. Table 2 presents the estimated parameters for the production frontier model. These parameters represent changes in the cassava output (kg) as a result of a unit change in the independent variables and as such show the relative importance of these variables to productivity of cassava. The result in Table 2 showed that farm size, labour and stem cuttings were the significant factors of cassava production among IP members while only farm size and stem cuttings were the significant factors among non-members of the platforms. The quantity of labour used in cassava production had the coefficient of 0.9 for IP members and 1.82 for non-members, and the coefficients were significant at $p<0.01$. This implies that increase in farm size by one hectare would likely lead to increase in cassava output by 90 kg and 182 kg for IP members and non-members, respectively. The coefficient of quantity of labour used in cassava production by IP members was 0.319 and significant at $p<0.05$ while the coefficient of quantity used by non-member was 0.279 but not significant. Thus the members of the Innovation Platform could increase their cassava output by 31.9 kg by increasing the man-day of labour working on the cassava farm by a unit while increase in labour employed would likely not have any effect on output. The stem cutting had negative coefficients of -0.64, which was significant at $p<0.05$ for members and -1.641 for noon-members, which was also significant at $p<0.01$. This implies that increase in stem cuttings used by members could lead to decrease in cassava output by 64 kg while there was higher tendency for a decrease in cassava output by 164.1 kg if the non-member increased the stem cuttings by one bundle.

Table 1. Distribution of respondent by social economic characteristics and socio – capital

Variables	Innovation Platforms (IPs)		
	Members (n=41)	Non-Members (n=59)	T-test
Socio economic characteristics			
Age	47.23	44.54	0.964
Household size	8.05	6.93	1.590
Years of experience	24.98	22.14	1.031
Years of education	6.29	7.27	0.982
Male (%)	56.1	74.6	
Married (%)	87.8	84.7	
Social capital of cassava farmers			
Number extension visits	3.34	1.61	1.750*
Number of social organizations	1.22	1.11	0.532
Decision making in family (%)	75.6	79.7	
Contact with research institution (%)	95.1	6.8	

**Significant at 10%*

Source: Field Survey, 2015.

Table 2. Technical efficiency estimates for cassava production in Oyo State Humidtropics field sites

Variables	Innovation Platforms (IPs)	
	Members (n = 41)	Non – Members (n= 59)
Constant (β0)	10.398(10.862)***	13.967(9.391)***
Farm size (β1)	0.900(3.219)***	1.817(4.076)***
Labour (β2)	0.319(2.546)**	0.279(1.289)
Fertilizers (β3)	0.010(0.182)	0.053(0.553)
Herbicides (β4)	-0.021(-0.328)	-0.036(-0.382)
Stem cuttings (β5)	-0.640(-2.393)**	-1.641(-3.817)***
Inefficiency Model		
Constant (δ0)	0.134(0.851)	0.485(0.434)
Age (δ1)	0.014(1.449)	-0.058(-1.669)*
Household size (δ2)	0.012(0.477)	-0.024(-0.369)
Years of experience (δ3)	-0.020(-1.972)**	0.087(2.620)***
Years of education (δ4)	-0.003(-0.104)	-0.048(-1.063)
Sex (δ5)	-0.579(-2.096)**	0.529(0.983)
Diagnostics Statistics		
Sigma squared (δ2)	0.180(4.183)***	0.534(2.111)**
Gamma (γ)	0.034(1.691)*	0.399(1.141)
Log likelihood function	-22.509	-56.598
LR Test	9.755	8.635

Note: ***,** and *Significant at 1%, 5% and 10%, respectively. The figures in the parenthesis () are t-values.

Source: Field Survey, 2015.

The technical efficiency score for both members and non-members are presented in Table 3. The mean efficiency score was significantly higher for members (0.8274) than for non-members (0.7249) at p< 0.01. This indicated that IP members had higher technical efficiency than non-members. By implication the members of the Innovation platform were more efficient in their combination of production input factor such as land, labour and stem cuttings used in the production of cassava. This suggests that IP members had gained the knowledge of best farming practices introduced by agricultural research institute to the platform, and monitored by the extension agents who were also available to provide help to farmers. The negative coefficient of stem cutting used indicates that the bundles of stem cuttings were no yet put to optimum use, though the IP members had been able to reduce the wastage of cassava stem used in the production than non- members. This finding depicts strong and effective network of social capital between those farmers that belonged to the platform and other stakeholders that resulted in dissemination of production information to enhance their efficiency.

Effects of social capital on efficiency of cassava production. Tobit regression estimates of the effects of social capital on the technical efficiency of cassava production between IP members and non-members are shown in Table 4. The results showed that the models were good fits. The log – likelihood estimates and the chi-square values were 63.7358 and 151.05 for members and 9.5324 and 60.66 for non-members, respectively, and these were significant at $p<0.01$. The dependent variable was the technical efficiency. This dependent variable was censored at their mean values for both IP members and non-members; those above the mean efficiency were considered as efficient in production of cassava while those below were considered as inefficient. The effect of the regressors on efficiency and their level of significance were also indicated.

Table 4 shows that the coefficients of contact with research institution for the IP members (0.0251) was postive and significant at $p< 0.10$ while for the non-members, the negative coefficient of -0.0284 was not significant. This implies that as farmers come in contact with research institution, their technical efficiency would be significantly increased by 2.51%. The coefficient for number of social organization the farmer IP members (-0.0051) had was also significant at $p<0.10$ but negative. This implies that as a member of the Innovation Platform increases his/her commitment by joining more social organization, the tendency is decrease in technical efficiency by 0.51%. Socio-economic factors such as education and years of experience and sex also showed positive and significant ($p < 0.01$) relationship with the technical efficiency for the IP members. The coefficients of social capital indices of non-members had no significant effect on their technical efficiency.

Membership in the Innovation platform significantly increased the social capital of cassava farmers. Thus, the platform provided avenues for farmers, researchers, private organizations, extension through their

Table 3. Technical efficiency score of cassava farmers

Technical efficiency Scores	Innovation Platforms (IPs) Percent members (n=41)	Percent mon-members (n=59)	T-test
Below 0.41	2.4	5.1	
0.41 – 0.60	9.8	11.9	
0.61 – 0.81	29.3	40.7	
0.81 – 1.00	58.5	42.7	
Minimum	0.37	0.18	
Maximum	0.99	0.94	
Mean	0.827	0.725	2.958***
Standard Deviation	0.178	0.165	

***Significant at 1%

Source: Field Survey, 2015.

interactions to achieve better cassava farming practices. Under the IPs, the cassava farmers also met researchers and the extension agents more often compared to non IP members. This gave room to knowledge exchange between the farmers and other stakeholders to improve the local practices in cassava farming to a more efficient combination of production inputs. The negative coefficient of number of social organization contradicts a' priori expectation (Bamire *et al.,* 2010). This suggests that not all the social organization the farmers join will contribute to efficiency, some organization may focus more on other activities with less attention given to farming that serves as their livelihood source.

CONCLUSION

In conclusion, socio economics characteristics of the farmers in this study area revealed that the Innovation Platform (IP) is relatively gender balanced and members of the IP increased their social capital through regular extension visits which provided them with information on efficient cassava production. The result of stochastic frontier production function estimates showed that the efficiency was higher for members of IP than non-members with

Table 4. Effects of Technical efficiency on social capital in Oyo State Humidtropics field sites

Variables	IP members (n=41)		IP non- members(n=59)	
	Maximum likelihood estimate (α)	t-ratio	Maximum likelihood estimate (α)	t-ratio
Contact with research institution	0.0251*	1.78	-0.0284	-0.35
	(0.0141)		(0.0817)	
No of social organization	-0.0051*	-1.95	0.0146	0.51
	(0.0027)		(0.0286)	
No of extension visit	-0.0007	-1.29	-0.0014	-0.35
	(0.0006)		(0.0040)	
Decision making	0.0071	1.46	0.0163	0.29
	0.0049		(0.0571)	
Farming experience				
	0.0120***	51.17	-0.0267***	-6.48
	(0.0002)		(0.0041)	
Education level	0.0036***	6.62	0.0136***	2.97
	(0.0005)		(0.0046)	
Age				
	-0.0072***	-33.46	0.0168***	4.79
	(0.0002)		(0.0035)	
Household size	-0.0091***	-7.79	0.0093	1.36
	(0.0012)		(0.0068)	
Sex	0.3308***	26.63	-0.1687***	-2.81
	(0.0124)		(0.0600)	
Constant	0.7868***	38.77	0.5864***	5.18
	(0.0202)		(0.1132)	
Sigma	0.0082		0.1077	
	(0.0013)		(0.0163)	
Chi^2	151.05		60.66	
$Prob>Chi^2$	0.0000		0.000	
Psuedo R^2	6.4065		1.4583	
Log likelihood	63.7358		9.5324	

Note: ***,* Significant at 1% and 10%, respectively. The figures in the parenthesis () represent standard error.
Source: Field Survey, 2015.

labour, farm size and stem making up the critical inputs in production while the non-members had farm size and stem cuttings only as the critical input. The role social capital plays on efficiency using Tobit regression estimates showed that farmer social capital network built through contacts with researchers by members of the innovation platform increased the efficiency of cassava production. However, joining a social organization without proper verification that it is farming oriented could likely lead to decrease in technical efficiency. It is therefore recommended that there should be creation of more innovation platforms and that farmers should be encouraged to participate in the platforms, so as increase their social capital which would in turn improve cassava production. There should be incentives for more youth and women to be actively involved in the development programme for more efficient production of cassava.

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STATEMENT OF NO-CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this paper.

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