Socio-economic, dynamics of farmers associations and adoption of sawah rice production technology in Nigeria and Ghana

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Abstract

The adoption of new agricultural techniques of which sawah rice production technology is an example, is a key route out of poverty for many in the developing world. This paper analyzed whether and how a farmer's decision to adopt a new technology depends upon the adoption decision of other farmers in their social group, which, unlike most of the existing literature, the paper is able to identify precisely. The use of various technologies depends on socioeconomic variables and the existence of different dimensions of social dynamics. Social dynamics is especially important in determining whether households have access to, and therefore use, different technologies. Although different studies have looked at social dynamics in terms of membership in groups, there is need to differentiate different kinds of social dynamics as they influence technology adoption differently. Social dynamics measured as bonding, bridging, and linking influence technology adoption. Overall the evidence suggests that network effects are important for individual decisions, and that, in the particular context of agricultural innovations, farmers share information and learn from each other. Individual adoption decisions depend upon the choices of others in the same social networks. Since farmers anticipate that they will share information with others, farmers are expected to be more likely to adopt when they know many other adopters. Dynamic considerations, however, suggest that farmers who know many adopters might strategically delay adoption to free-ride on the information gathered by others. The specific application of the socio-economic and dynamics of farmers association to adoption was explained through a cross sectional data collected from adopters and non adopter of sawah rice technology in Ghana and Nigeria. The paper concludes that the externalities which play important role in technology-adoption decisions are network, market power and learning externalities. The study recommends investments, especially by development organizations, in strengthening these different forms of social dynamics by supporting local kinship or community groups that generate social dynamics, promoting farmer access and links with external organizations that can act as sources of information and technologies for farmers, as well as links with other farmer associations and groupings from whom they can learn.

Keywords: socio-economic, dynamics, social groups, networks, externalities, adoption, sawah, rice,

Introduction

The importance of farmers' adoption of new agricultural technology has long been of interest to agricultural extensionists and economists. Several parameters have been identified as influencing the adoption behaviour of farmers from qualitative and quantitative models for the exploration of the subject. Social scientists investigating farmers' adoption behaviour have accumulated considerable evidence showing that demographic variables, technology characteristics, information sources, knowledge, awareness, attitude, and group influence affect adoption behaviour. Adoption of innovations refers to the decision to apply an innovation and to continue to use it[1] . A wide range of economic, social, physical, and technical aspect of farming influences adoption of agricultural production technology. Earlier evidences[2] led to the categorization of adoption behavior into innovators, early adopters, early majority, late majority and laggards. This is based on validated studies that the adoption behaviour of any agricultural technology would follow a normal distribution curve in a given social system. The increasing importance of rice towards world food security has been stressed through the green revolution in Asia and the increasing consumption of rice among world's poor. Aker et al[3] stated that although rice is grown by efficiently by small scale farmers, a successful rice economy needs sophisticated engagements from government to develop the economies o scale and scope that permit a low-cost rice system- an engagement that has largely been missing in West Africa.

Sawah rice production technology

The concept and the term "sawah" refers to man-made improved rice fields with demarcated, leveled, bunded and puddled rice fields with water inlet and water outlet, which, if possible, can be connecting various irrigation facilities, such as irrigation canals, pond, spring, pump, water harvesting, and flooded sawah. Gajigo and Dennning[4] noted that the presence of irrigation technology is a significant factor in explaining the variation in rice production in West Africa. The Sawah system was introduced through on-farm adaptive research in the two research sites of Gara and Gadza inland valleys, located in the Bida, Nigeria in 1986[5]. Sawah based rice production development started with three individual farmers in three villages with 0.1ha in total area in 2001. The establishment of a demonstration field (1.0 ha) at Ejeti village in 2002 galvanized the project. In 2002 the number of farmers increased in the Sawah Package program and by 2003 the farmers increased to fourteen and in 2004 to eighteen farmers from four villages. In 2005, the farmers of the 'Sawah Package' have increased to 83 from five villages covering more than 20ha area[6]. This spread and adoption of sawah which grow in leaps and bounds spreading over additional five states between 2005 and 2010 with over and estimated 10,000 adopters affirms its wide acceptance due to its improvement over the traditional system of rice farming in terms of yield , sustainable land use and the on farm demonstration method whose result in terms of field fact as witnessed by the farmers has been very convincing. Gajigo and Dennning[4] reported that after controlling for rice area harvested and per capital income, both total rice production and yield are significantly correlated with the proportion of the area irrigated.

Social dynamics and adoption

The adoption of new agricultural techniques is a key route out of poverty for many in the developing world. Yet, agricultural innovations have often been adopted slowly and some aspects of the adoption process are still poorly understood. Recent studies have shown that, both in developing and developed countries, social networks and peer effects are an important determinant of individual behaviour in a variety of settings. An integral part of sustained poverty reduction efforts is the use of improved high yielding variety seeds and sustainable use of natural resources[7]. At the farmer level, although there are many factors that influence adoption and use of these technologies, studies have shown that rural communities that are characterized by strong social dynamics have faster rates of technology diffusion and improved environmental management[8]. According to[9], social dynamics influence the use of technologies differently; for example, technologies that are knowledge intensive may require different forms of social dynamics than those that are labour or input intensive. Studies on the links between social dynamics and agricultural technologies have, however, not differentiated the different forms of social dynamics and how these influence the adoption and utilization of different technologies. Social dynamics or capital is the establishment of norms that permit people to work in groups, hence social capital is the consequence of intensely rooted cultural habits[10], and as a result, it is defined differently in different cultural settings. The vast literature on social capital further refines its definition to distinguish between bonding, bridging, and linking social capital.

Social learning and information spillovers have been described as important driving force in models of endogenous growth. Conley and Udry[11] reported that farmers within a group learn from each other how to grow new crop varieties. In relation to this, externalities have been identified to be important in technology-adoption decisions. The dynamic choices with externalities include the sources such as (i) Network Externalities. -Adopters care about how many other individuals adopt because there is some public-good element to the technology. Market Power Externalities. -Adopters with market power will care about adoption by others if adopting early implies some advantage in market power; and Learning Externalities.-Farmers may care about others' adoption decisions if early adopters teach late adopters something.

Bonding social capital is generally defined as closed networks of close friends and relatives or horizontal relationships among equals within a localized community[8]. It is the social cohesion that takes place between individuals of similar ethnic backgrounds or social status and it is reinforced by working together. Szreter and Woolcock[12] define bonding social capital as the trusting and cooperative relations between members who are similar in a socio-demographic sense. Some examples of this type of social capital include formal and informal clubs, groups, or associations established by farming communities in many villages across SSA. These groups may be formed through church affiliations, local traditional structures, or other localized structures. Bonding social capital is thus characterized by trust and norms that exist within the social structure. Bridging social capital, on the other hand, is widely agreed to be vertical relationships or networks that cross social groupings. These are established between people or organizations that are removed from each other and are in different communities[8].

Bridging social capital links networks requiring collaboration and coordination with other external groups to achieve set goals; for example, it can be the link between two local groups from different villages. Leonard and Onyx [13] use five indicators of social capital (networks, reciprocity, trust, shared norms, and social agency) to define bonding and bridging social capital. Bonding social capital was described as being characterized by dense, multiplex networks, long-term reciprocity, thick trust, shared norms, and less instrumentality, whereas bridging social capital is characterized by large, loose networks, relatively strict reciprocity, and a thinner or different type of trust and more instrumentality. Linking social capital is the engagement of local groups or networks with institutions or agencies in higher influential positions[9]. Through linking social capital, groups of poor people are able to access support, resources, and information from organizations and networks. Woolcock and Narayan[14] see bonding social capital as operating as a defense mechanism against poverty, whereas bridging social capital is what required for real economic growth to take place. The three types of social capital, therefore, complement each other, in that the strong bonds existing in bonding social capital are diversified by the existence of bridging social capital, whose bonds are weaker but more cross cutting, hence enabling increased diversity in an otherwise closed community. Linking social capital allows for the accumulation of resources, information, and wealth, which is needed by networks to achieve set objectives. Hence, all three types of social capital can coexist in a community to different extents, but more frequently one maybe more prominent.

This paper analyzed whether farmers' decision to adopt a new technology depends upon the adoption decision of other farmers in his social group, which, unlike most of the existing literature, where the influence of group membership has been used as a composite variable. To capture the different effect of indicators o group membership. This paper examined the social dynamics within group membership. There is, therefore, a need to examine multiple indicators for measuring the different forms of social dynamics and how these forms influence technology adoption. The objective of this paper was to examine the influence of social dynamics on the adoption of sawah rice production technology in Nigeria and Ghana.

Methodology

The study was carried out in Nigeria and Ghana, and covered 12 fields in Nigeria with 80 farmers while in Ghana 11 fields in 5 villages (Adugyama, Biemso No 1, Biemso No2, Fediyeya and Attakrom) were covered with 70 farmers. The field locations in Ghana are in the Ahafo Ano South district. Ghana is located on West Africa's Gulf of Guinea only a few degrees north of the Equator on Latitude: 5 degrees, 36 minutes north, Longitude: 0 degrees, 10 minutes east. This area, known as the "Ashanti," produces most of the country's cocoa, minerals, and timber. The climate is tropical with two distinct rainy seasons in the south-May-June and August-September; in the north, the rainy seasons tend to merge. The choice was necessitated by the fact that all sawah development projects have concentrated on the Ahafo Ano South distircts. In Nigeria, most of the fields covered are in Bida area of Niger state, while a village (Pampaida) was covered in Kaduna state and Akure in Ondo state. Villages covered in Bida area include Shabamaliki, Ejeti, Ekapagi, Nasarafu, Etsuzegi and Gadza. Bida, has a clayey loamy, sandy soil, under the guinea savannah ecology and is 137 m above sea level and lies on longitude 6°01'E and latitude 9°06'N in Niger State of Nigeria. Data were collected in June 2010 in all the villages where sawah rice production technology had been introduced and adopters of sawah technology were interviewed. A structured questionnaire with a reliability coefficient of 0.85 was used to elicit information on socio-economic characteristics and social dynamic. Descriptive statistics was used to describe the data while Probit model was used to analyze the adoption with particular reference to the effects on the spread of the technology.

A probit model is appropriate when the dependent variable to be evaluated is dichotomous[15,16]. The relationship between the probability of a variable Pi and its determinants q is given as:

$$Pi = \beta qi + \mu i \ldots\ldots (1)$$

Where Pi=1 for Xi>Z; i=1, 2 ......, n; qi is a vector of explanatory variables and β is the vector of parameters. The probit model computes the maximum likelihood estimator of β given the non-linear probability distribution of the random error μi. When the dependent variable takes more than two values and these two values have a natural ordering, the use of an ordered probit is indicated and estimated using the maximum likelihood method.

In the probit model the discrete dependent variable Y is a rough categorization of a continuous, but unobserved variable Y^*. If Y^* could be directly observed then standard regression methods would be used (such as assuming that Y^* is a linear function of some independent variables, for example:

$$Y^* = \beta_1 X_{1i} + \ldots\ldots\ldots \beta_j X_{ji} + ui \ldots\ldots(2)$$

In this study, Y^* is the adoption of sawah technology which is used as a proxy for Y^*.

The actual model specification is: adoption of sawah technology = β_0 + $\beta_1$age + β_2 educational level + β_3 membership of farmers' groups + β_4 Membership of formal and informal clubs + β_5 Membership of traditional structures + β_6 Membership of localised structures + β_7 Shared norms among farmer groups + β_8 Extent of trust among farmers + β_9 Transport for easy network + β_{10} Network with financial institutions for credit + β_{11}farming experience + β_{11} Land tenure system + β Household size + *u*

The dependent variable Pi is a dichotomous variable which is 1 when a farmer adopts sawah technology and 0 if otherwise. The explanatory variables are: X_1 = age in years, X_2 dummy variable for educational level (formal education = 1, No formal education = 0); X_3 = dummy variable for membership of farmers groups (Yes = 1, No = 0); X_4= dummy variable for membership of formal and informal clubs (Yes = 1, No = 0); X_5 = dummy variable for membership of traditional structures (Yes = 1, No = 0); X_6 = dummy variable for dummy variable for membership of formal localized structures (Yes = 1, No = 0); X_7 = dummy variable for shared norms among farmers groups (Yes = 1, No = 0); X_8 = dummy variable for extent of trust among farmers (Yes = 1, No = 0); X_9 = dummy variable for transport for easy network (Yes = 1, No = 0); X_{10} = dummy variable for network with financial institutions (Yes = 1, No = 0); X_{11} = farming experience in years; X_{12} = dummy variable for land tenure system (inherited = 1, otherwise = 0); X_{13} = household size in terms of number of persons.

Results and Discussion

Table 1 shows the socio-economic characteristics of farmers adopting sawah rice production technology in Nigeria and Ghana. The table shows that in Nigeria, majority of the farmers are about 43 years of age having quranic form of education, belonging to at least one farmers group and have been farming for about 13 years. The land tenure system is predominantly through inheritance while the mean score for household size among farmers was 4.6. In Ghana, the mean age is about 45 years with most farmers having attended primary school, and belonging to farmers groups. There is an average of 17 years in terms of farming experience and land tenure system was based on secured renting.

Table 1: Socio-economic characteristics of respondents

Household and social dynamic characteristics	**Description**	
	Nigeria	**Ghana**
Age	Mean = 42.86	Mean = 45.70
Educational level	Predominantly Quranic	Predominantly primary school
Membership of Farmer group	Predominantly members	Predominantly members
Membership of formal and informal clubs	Predominantly Yes	Predominantly Yes
Membership of traditional structures	Predominantly Yes	Predominantly Yes
Membership of localised structures	Predominantly Yes	Predominantly Yes
Shared norms among farmer groups	Predominantly Yes	Predominantly Yes
Extent of trust among farmers	Predominantly low	Predominantly high
Transport for easy network	Predominantly low	Predominantly high
Network with financial institutions for credit	Predominantly No	Predominantly Yes
Farming experience	Mean = 13 years	Mean = 17 years
Land tenure system	Predominantly Inheritance	Predominantly secured rent
Household size	Mean = 4.6	Mean = 7.2

The results from the probit model in Table 2 showed that the coefficients for 12 variables were significant each in Nigeria and Ghana. For Nigeria and Ghana respectively, these are age (t = 4.12, p < 0.05; t = 7.20, p < 0.05) educational level(t = 2.77, p < 0.05; t = 2.32, p < 0.05) ; membership of farmers groups(t = 1.93, p < 0.05; t = 2.57, p < 0.05); membership of formal and informal clubs(t = 2.29, p < 0.05; t = 9.63, p < 0.05) ; membership of traditional structures(t = 2.50, p < 0.05; t = 2.85, p < 0.05); membership of formal localized structures (t = 2.45, p < 0.05; t = 5.00, p < 0.05) ; extent of trust among farmers(t = 3.35, p < 0.05; t = -2.45, p < 0.05) ; transport for easy network(t = -1.73, p < 0.05; t = 4.24, p < 0.05); farming experience(t = 2.49, p < 0.05; t = 4.04, p < 0.05), land tenure system(t = -3.35, p < 0.05; t = -2.45, p < 0.05); and household size(t = 2.31, p < 0.05; t = 2.52, p < 0.05). The sign for each coefficient is consistent with the expectation; as the probability of adoption of sawah rice production technology increases, age, educational level; membership of farmers groups; membership of formal and informal clubs; membership of traditional structures; membership of formal localized structures ; extent of trust among farmers; transport for easy network; farming experience, land tenure system and household size increases. Anim and Mandleni [17] found that all three types of social dynamics, bonding, bridging and linking affect technology adoption to some extent but bridging which includes trust shared norms and ownership of assets was the most predominant among farmers in Limpopo province in South Africa. Njuki et al [18] found that bonding, bridging, and linking social capital all influence the adoption and use of different soil management options differently, a trend that might be similar for other agricultural technologies as well.

Table 2: Parameter estimates from Probit regression model

	Nigeria	Ghana
Variables	Coeff./S.E.	Coeff./S.E
Age	4.12	7.20
Educational level	2.77	2.32
Membership of Farmer group	1.93	2.57
Membership of formal and informal clubs	2.29	-9.63
Membership of traditional structures	2.50	2.85
Membership of localised structures	2.45	5.00
Shared norms among farmer groups	1.34	-0.082
Extent of trust among farmers	3.35	2.45
Transport for easy network	1.73	4.24
Network with financial institutions for credit	-0.80	-0.016
Farming experience	2.49	4.04
Land tenure system	-3.35	-2.45
Household size	2.31	2.52
Intercept	-2.15	-18.00

Pearson Goodness-of-Fit Chi Square	110.02	301.22
Df	78	68
P	0.00	0.000

Conclusion

The study has shown that social dynamics affect technology adoption sawah rice production technology. In both countries the adoption of sawah rice production technology was influenced by social dynamic variables such as membership of farmers groups; membership of formal and informal clubs; membership of traditional structures; membership of formal localized structures ; extent of trust among farmers and transport for easy network.The disaggregation of the social dynamics variable has shown critical areas for the extension agents, sawah staff and development agencies to concentrate in terms of the effect of social capital on adoption for the overall scaling of the scale. The study recommends investments, especially by development organizations, in strengthening these different forms of social dynamics by supporting local kinship or community groups that generate social dynamics, promoting farmer access and links with external organizations that can act as sources of information and technologies for farmers, as well as links with other farmer associations and groupings from whom they can learn.

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