Identification of Factors Affecting Adoption of Improved Rice Varieties among Smallholder Farmers in the Municipality of Malanville, Benin

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ABSTRACT

Adoption of improved rice varieties is important for improving rice yield in Benin. This study employed a double-hurdle model to assess factors influencing the adoption of improved rice varieties using a cross-sectional dataset of 360 farmers randomly selected in the municipality of Malanville in Benin. Estimation of the first hurdle indicates that education, frequency of extension visits, frequency of farmer-based organization meetings, access to credit, participation in market, off-farm activities, fertilizer use, perception of soil fertility, access to media and ownership of mobile phone play significant roles in adoption decision-making process in the municipality of Malanville. The results from the second hurdle show that the land under improved rice is positively associated with education, rice-farming experience, credit, off-farm activities, and soil fertility. These findings suggest a strong institutional support measures for promoting the improved rice varieties in Benin.

Keywords: Double-hurdle model, Rice production policy, Sub-Saharan Africa, Tobit model.

INTRODUCTION

Rice, in sub-Saharan Africa, is produced in five main ecosystems, including rainfed uplands, rainfed lowlands, irrigated ecosystem, inland swamps, and mangrove swamps (Norman and Otoo, 2003; Katic *et al*., 2013). In Benin, rice production depends fundamentally on the climatic conditions, as majority of the rice is produced under rain-fed conditions. Only about 2 % of rice area is irrigated. Rice is grown throughout the country, but the main producing regions are Alibori, Borgou, and Zou. It is grown as monoculture in the irrigation schemes, where annual double-cropping is practiced and inter-cropped with oil palm, banana and some subsistence crops, such as cassava, maize, and vegetables, or in rotation in the inland valleys, where rice is often followed by vegetable crops, such as pepper, okra, tomato.

As a result of rapid population growth in Benin, rice consumption has increased across years from 2.9 kg per capita per year in 1965 to 15 kg per capita per year in 1994 and currently to 45.7 kg per capita per year [Ministère de l'Agriculture, de l' Elevage et de la Pêche (MAEP), 2017]. Despite increase in the national production from 16,545 Metric Tons (MT) in 1995 to 72,960 MT in 2007 and to 234,145 MT in 2015 (MAEP, 2015a), the net demand for rice in Benin is high and is often fulfilled by importing rice. To reduce the gap between demand and supply of rice in Benin, the main challenge is to increase yield, as it is still low at about 3.3 MT per hectare (MAEP, 2017). In this regard, the eight main strategies defined in the rice policy of Benin to enhance rice production include: (1) Making good quality rice seed available and affordable, (2) Making fertilizers, pesticides and specific herbicides available and affordable, (3) Rice processing and marketing, (4) Water control for practical

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rice production, (5) Access to and maintenance of agricultural equipment, (6) Access to technical innovation and professional know-how, (7) Access to credit and tailored agricultural finance, and (8) Access to land.

The rice policy in Benin encourages adoption of high-yielding rice varieties as an option for smallholder farmers to enhance rice productivity. Despite efforts made by the state, adoption of improved varieties remains low in the agricultural sector in Benin, covering only 25% of the total cultivated area (MAEP, 2015b). According to the world food program (WFP, 2014), only 7 % of the farmers in Benin had used improved varieties during the 2012/2013 cropping season. In Benin, rice producers directly purchase improved rice varieties through formal and informal sectors. The informal seed sector has no clear structure, no clear mechanism for information sharing, and no clear procurement systems. The availability of seeds depends on a few farmers who produce them under no control mechanisms. They are not specifically trained for seed production. The majority of rice producers use seeds from past harvest. These seeds are maintained in conditions that are not conducive for good germination and result in lower rice productivity per acre. Rice yield remains low in Benin and is decreasing from 3.9 MT per hectare in 2011 to 3.1 MT per hectare in 2015 (MAEP, 2017). To improve rice productivity in Benin, adoption and diffusion of improved rice varieties is crucial. Past studies indicate that the use of improved crop seed not only contributes to yield improvement (Just and Zilberman, 1988; Nata *et al*., 2014; Ghimire *et al*., 2015), but also helps in improving livelihoods of smallholder farmers (Asfaw *et al*., 2012; Afolami *et al*., 2015).

Adoption of improved seed in African countries is constrained by several factors, including lack of information on seed availability, relatively high price of improved seed for the poor smallholder farmers, producers' risk-aversion, poor access to improved seed, and lack of credit (Rohrbach and Tripp, 2001; Langyintuo *et al*., 2008; Chandio and Yuansheng, 2018). The results of previous studies (Pannell *et al*., 2006; Shiferaw *et al*., 2008; Udoh and Omonona, 2008; Dandedjrohoun *et al*., 2012; Owusu and Donkor, 2012; Afolami *et al.,* 2015; Chekene and Chancellor, 2015; Ghimire *et al.,* 2015) indicate that socio-economic characteristics, institutional variables, and the innovation characteristics are factors that influence the technology adoption process. For instance, Udoh and Omonona (2008) found educational attainment, access to extension agents, access to credit, access to inputs, farm size, and crop yield as significant determinants of adoption of improved rice varieties in Akwa Ibom State of Nigeria. Similar results were found by Chekene and Chancellor (2015), who showed that age, rice farming experience, being a member of farmers' association, and access to extension services and credit were the factors that determined adoption of improved rice varieties in Borno State of Nigeria. These results were also found by Umeh and Chukwu (2015) in Ebonyi State of Nigeria. A study by Asmelash (2014) revealed that gender of the household head, membership of farmers-based organization, access to extension services and market were key factors that influence the decision of adopting upland rice varieties in Ethiopia. Recently, Ghimire *et al*. (2015) have found extension services, education and seed access as key variables in adoption decision of improved rice varieties in Central Nepal.

This study aimed to provide answer to the following research question: what factors inform farmers' decision to adopt improved rice varieties in Benin? It can be seen from the previous studies (Udoh and Omonona, 2008; Dandedjrohoun *et al*., 2012; Asmelah, 2014; Chekene and Chancellor, 2015; Ghimire *et al*., 2015; Chandio andYuansheng, 2018) that the factors that encourage adoption of improved seed differ across countries and are location-specific. This is because of variability in climatic conditions and natural resources, political

conditions, agricultural practices, and socio-economic and demographic factors as well as institutional variables. Therefore, there is a need for specific investigation to support seed policy in Benin. In line with this, the paper adds to knowledge on the factors that facilitate adoption of improved seed with focus on the improved rice varieties. Few studies (Dandedjrohoun *et al*., 2012; Allagbé and Biaou, 2013; Seye *et al*., 2016) have attempted to explain the low adoption of improved rice varieties in Benin. So far, this issue has not been sufficiently addressed. None of previous studies in Benin included the municipality of Malanville, which is the largest rice producing area in Benin. In 2015, the municipality of Malanville produced 27% of total rice in Benin (MAEP, 2017). Furthermore, by using generally a binary response model (adoption versus non-adoption), these studies ignored the intensity of improved rice adoption and thus excluded the factors that affect the amount of land devoted to improved rice. The present study contributes to fill this gap by using a double-hurdle approach that allows for estimation of both factors affecting adoption and intensity

of the improved rice.

MATERIALS AND METHODS

Study Area and Sampling Technique

The study was conducted in the municipality of Malanville in Benin (Figure 1). This municipality is known as the largest rice area in Benin. The municipality is located in northern Benin. It shares an international boundary with the Republic of Niger to the North and the Federal Republic of Nigeria to the East. It also shares a local boundary with the municipalities of Kandi and Ségbana to the South and the municipality of Karimama to the West. It covers an area of 3,016 km², of which 8,000 hectares is arable land. The municipality is located in the Sudano-Sahelian zone of Benin and is characterized by one dry season and one wet season, which lasts for 5 to 6 months from May to October, with a rainfall range of 700 to 1,000 mm. Majority of the inhabitants are involved in subsistence agriculture and other economic activities,
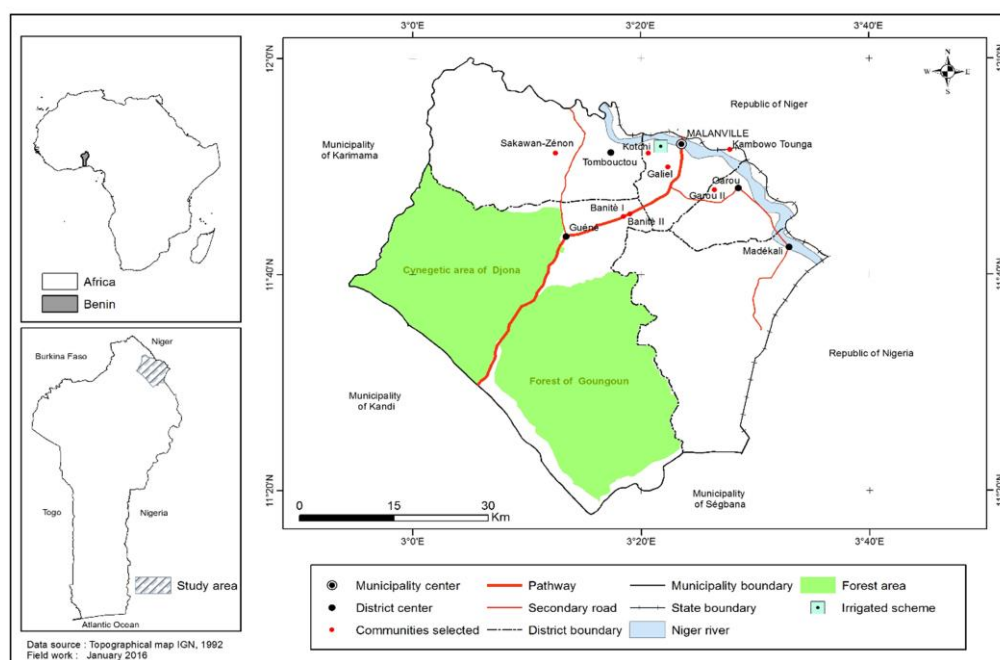

Figure 1. Map of study area.

such as fishing, livestock rearing, small business, trade and crafts. The main crops grown are maize, rice, millet, sorghum, cotton, and vegetables. About 35% of the population was food insecure in 2013 [Institut National de Statistique et de l'Analyse Economique (INSAE), 2013].

A multistage-sampling technique was used in this study to select the respondents. In the first stage, the municipality of Malanville was purposively selected because it is the largest rice-producing municipality in Benin. In the second stage, four districts out of the five in the municipality were randomly selected. The districts selected were Garou, Guene, Malanville and Tombouctou. In the third stage, two villages were randomly selected from each district. In total, eight villages within the municipality were covered in the survey. In the last stage, 45 rice farmers were randomly selected from each village. This provided a total of 90 rice farmers in each district. The total sample size for this study was 360 rice producers.

Empirical Model

This study used a random utility framework to describe the farmers' choice to adopt improved rice varieties for farming. The farmer was considered as an adopter when he/she planted improved rice varieties. Similarly, the farmer was considered as a non-adopter if he/she cultivated the traditional or local rice varieties. In the utility framework, farmers were assumed to maximize their utility derived from the adoption of a new improved rice variety.

Let U_{i1} denote the utility derived from the adoption of improved rice varieties and U_{i0} the utility derived from not adopting the improved rice varieties. The difference in utility from improved rice varieties adoption and non-adoption is denoted U_i. Farmer i will decide to adopt an improved rice variety when it provides him a utility greater than the case of non-adoption. Mathematically, $U_i = U_{i1} - U_{i0} > 0$. In practice, the utilities are not observables; what we

observe is the farmer's decision to adopt or not to adopt improved rice varieties. However, farmers are also faced with the decision of what amount of land to be planted to the improved variety of rice. Thus, the double-hurdle model was used to allow for the two-stage estimation. Initially formulated by Cragg (1971), the double-hurdle relaxes the restrictions of Tobit model by assuming two hurdles in the process of adoption of improved rice varieties. The first hurdle relates to the farmer's decision to adopt improved rice varieties and the second to the decision on the intensity of land devoted for improved rice varieties cultivation. The double-hurdle model is expressed as follows:

$$Y_{1i}^* = \beta_1 X_i + \varepsilon_1 \quad \text{Adoption decision} \quad (1)$$

$$Y_{2i}^* = \beta_2 X_i + \varepsilon_2 \quad \text{Intensity decision} \quad (2)$$

$$Y_i = \beta_i X_i + \varepsilon_i \quad \text{if} \quad Y_{1i}^* > 0$$
$$Y_{2i}^* > 0 \quad (3)$$

$$Y_i = 0 \text{ otherwise} \quad (4)$$

Where, Y_{1i}^* is the latent variable describing the likelihood of farmer i to adopt improved rice varieties (it takes the value of "1" if the farmer adopted the improved rice varieties and "0" if not); Y_{2i}^* is the latent variable representing the extent (area planted to improved rice) of adoption of improved rice varieties; Xi is a vector of independent variables; βi is the parameter vector to be estimated; and ε_1 and ε_2 are the errors terms, assumed to be independent and normally distributed. The double-hurdle model is estimated using probit model for the adoption decision and truncated normal regression model for the intensity equation. Stata commands "craggit" (Burke, 2009) and "dblhurdle" (Garcia, 2013) also provide consistent estimates of the double-hurdle model; however, to avoid convergence problems, a separate estimation procedure was used. Bootstrapping is used to adjust standard errors for the two-step procedure (Bezu *et al.*, 2014). A log-likelihood test was performed to support the choice of the double-hurdle model in this study. The

likelihood ratio statistic (λ) was computed as follows:

$$\lambda = 2(LL_{probit} + LL_{truncreg} - LL_{tobit})$$

(5)

Where, LL_{probit}, $LL_{truncreg}$ and LL_{tobit} represent the log likelihood values from the probit, truncated regression and Tobit estimations, respectively. The likelihood ratio statistic (λ) has a Chi-square distribution, with a degree of freedom equal to the number of explanatory variables, including the intercept (Greene, 2003; Sinyolo *et al*., 2017). The Tobit model would be rejected in favor of the double hurdle if the value of the likelihood ratio statistic exceeds the Chi-square critical value (Burke, 2009; Sinyolo *et al*., 2017).

The general empirical model is as follows:
For the adoption decision:

$$Y_{1i} = \beta_0 + \sum_{j=1}^{k} \beta_{ij} X_{ij} + \varepsilon_1 \qquad (6)$$

For the intensity decision:

$$Y_{2i} = \alpha_0 + \sum_{j=1}^{k} \alpha_{ij} X_{ij} + \varepsilon_2 \qquad (7)$$

The variables used in the double-hurdle model were socio-economic and demographic characteristics of the farmers as well as farm level characteristics and institutional variables. Variables, such as gender, education, and experience in rice production were included to capture the individual characteristics of the farmer. Gender (a dummy variable)= 1 for male and 0 for female. It was postulated that the adoption of improved varieties might be biased by gender because of the difference in access to productive resources. Men were considered more likely to access information and farm inputs than women (Asmelah, 2014; Namonje-Kapembwa and Chapoto, 2016; Addison *et al*., 2018). Therefore, it is hypothesized that being a man would increase the likelihood of adopting improved rice varieties. The variable education equals 1 if the farmer had at least primary-school education and 0 otherwise. Udoh and Omonona (2008), Ghimire *et al*. (2015) and Verkaart *et al*. (2017) found a positive relationship between education and the use of improved rice varieties. Educated farmers are expected to have a high probability of adopting improved rice varieties. Experience in rice production is a continuous variable measured in number of years in rice production. Umeh and Chukwu (2015) have shown a significant effect of experience in rice production on the likelihood of adoption of improved rice varieties. Experienced farmers are more likely to adopt improved rice varieties.

The farm-characteristics variables used in the analysis included farm size and soil fertility. Farm size is a continuous variable expressed in hectares. It is expected that as farm size increases, the probability of adoption of improved seed increase. Farmers with large farm size are assumed to have more resources for crop production (Beke, 2011; Zarafshani *et al*., 2017). Studies by Alene *et al*. (2000), Bezu *et al*. (2014) and Verkaart *et al*. (2017) have shown that the probability of adoption and intensity of improved seed variety increases with farm size. Soil fertility (a dummy variable) takes the value 1 if the farmer perceived the soil as good, and 0 otherwise. It is expected that soil fertility may have a positive influence on the adoption and intensity of improved seed.

The institutional variables used in the analysis were frequency of extension services, frequency of Farmer-Based Organization (FBO) meetings, and access to credit and participation in market. Frequency of extension services is a continuous variable measured in number of times the farmers had been paid a visit by extension staff in a year. It is postulated that regular contact with extension agents will increase the probability of adoption of improved rice varieties. Positive effect of the extension services on the probability of adoption of improving rice varieties have been shown by Saka and Lawal (2009), Asmelash (2014) and Ghimire *et al*. (2015). The frequency of FBO meeting is a continuous variable, indicating the number of times the farmer participated in the FBO meeting. It is expected that being a member

of a FBO increases the likelihood of farmer adopting improved rice varieties. Conley and Udry (2010) argue that learning from the new technology may occur through farmers' network. Access to credit is a dummy variable, which takes a value of 1 if the farmer obtained credit, and 0 otherwise. It is postulated that access to credit increases farmers' financial capacity and enables them to purchase farm inputs in time (Beke, 2011; Mdemu *et al.*, 2017; Nonvide *et al.,* 2018). A study by Chekene and Chancellor (2015) showed that access to credit was positively associated with the adoption of improved rice varieties. Proportion of rice sold is used as proxy for market participation. This variable shows the intensity of the participation in market. A positive relationship between market participation and the likelihood of adopting improved rice varieties is expected. Participation in market increases not only the farmers' financial capacity through sale of agricultural products but also facilitates access to information (availability of seed, price, among others) on the new technology. Asmelash (2014) has shown a positive effect of access to market on the decision to adopt improved rice varieties.

Access to media and ownership of mobile phone were dummy variables with a value of 1 if the farmers owned a radio or TV or mobile phone. Through these channels, the farmers could collect information on the new technology (Sangbuapuan, 2012; Nzonzo et Mogambi, 2016). Off-farm activity was a dummy variable with a value of 1 if the farmers participated in off-farm works, and 0 otherwise. Engagement in off-farm activities increases farmers' financial capacity and the off-farm income may be reinvested in the farm. Therefore, the study assumes that engagement in off-farm activities positively influences the decision to adopt improved rice varieties.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Surveyed Rice Farmers

Summary statistics of the characteristics of the surveyed rice farmers are presented in Table 1.

About 44% of the rice farmers adopted the improved rice varieties. Overall, there were important differences between the improved rice varieties adopters and non-adopters, except for the variable gender. The average age of the adopters of improved rice varieties was 43 years, against 40 years for the non-adopters, implying that the adopters of

Table 1. Socio-economic characteristics of the respondents.

Variable definition	Adopters (Mean)	Non-adopters (Mean)	t-Test/ $\chi 2$ Value
Improved rice variety (Yes= 1, No= 0)	44	56	-
Age of the farmer (Number of years)	43.14	40.03	-3.17[***]
Gender (Male= 1, Female= 0)	0.77	0.72	1.41
Education (0= None, 1= At least primary school)	0.57	0.26	29.06[***]
Rice farming experience (Number of years)	14.80	11.42	-4.62[***]
Frequency of extension visit (Number of visits)	2.9	1.2	-12.52[***]
Frequency of FBO meeting (Number of meetings)	2.65	0.68	-13.70[***]
Credit access (Yes= 1, No= 0)	0.65	0.40	23.12[***]
Market participation (Proportion of rice sold)	66.08	54.24	-5.24[***]
Off farm activity (Yes= 1, No= 0)	57.5	39	22.47[***]
Farm size (Number of hectare under rice production)	1.74	1.32	-3.55[***]
Soil fertility (Good= 1, Poor= 0)	0.71	0.47	21.72[***]
Access to media (Yes= 1, No= 0)	0.66	0.47	12.67[**]
Ownership of mobile phone (Yes= 1, No= 0)	0.89	0.57	44.47[***]

 *** Significant at 1%,   ** Significant at 5%.

improved rice varieties were relatively older compared to the non-adopters. The adopters had spent, on average, 15 years in rice farming, against 11 for the non-adopters. This suggests that adoption of improved rice varieties may be determined by farmers' experience in rice farming. Significant difference was noted in the educational level of adopters of improved rice varieties and non-adopters. About 54% of farmers who adopted improved rice varieties had at least primary education, against 26% of the non-adopters. This shows the importance of education in the technology diffusion process.

Average farm size was 1.74 hectares (ha) for adopters and 1.32 ha for non-adopters. About 71 and 42%, respectively, adopters and non-adopters perceived their soil as fertile. Positive perception of the soil fertility is likely to be associated with the adoption of improved rice varieties by the farmers. About 65% of farmers, who adopted the improved rice varieties, had access to credit against 40% of the non-adopters. This suggests that secured credit facilitates adoption of new technologies. Farmers that had access to credit were more motivated to adopt high yielding seed. Mdemu *et al*. (2017) argue that lack of credit hinders farmers from securing farm inputs (improved seed, fertilizer, agrochemicals and storage facilities, among others) in time. Lack of credit is the main constraint in rice farming in Benin (Nonvide *et al*., 2018). As regards access to media and ownership of mobile phone, significant differences were noted between the adopters and non-adopters. About 66% adopters and 47% non-adopters of improved rice varieties owned a radio or television. In addition, about 89% of the adopters had a mobile phone against 57% of the non-adopters. Through radio, television or mobile phone, farmers can gather information on the new technologies. Ownership of a radio, TV and mobile phone could facilitate the adoption of improved rice varieties by farmers.

Factors Affecting Adoption and Intensity of Improved Rice

Results from the double-hurdle model are shown in Table 2. The log-likelihood test

Table 2. Double hurdle model estimates of improved rice adoption.

Variable definition	Probability of adopting improved rice (Hurdle 1)		Land under improved rice (Hurdle 2)	
	Coeff	Bootstrap s.e	Coeff	Bootstrap s.e.
Gender (Male= 1, Female= 0)	- 0.108	0.270	- 0.027	0.069
Education (0= None, 1= At least primary school)	0.402*	0.223	0.255***	0.056
Rice farming experience (Number of years)	0.025	0.015	0.007*	0.004
Frequency of FBO meeting (Number of meetings)	0.303***	0.099	0.005	0.032
Frequency of extension visit (Number of visits)	0.342***	0.090	0.015	0.045
Credit access (Yes= 1, No= 0)	0.619***	0.223	0.127**	0.059
Market participation (Proportion of rice sold)	0.017***	0.005	- 0.001	0.001
Off farm activity (Yes= 1, No= 0)	0.603***	0.231	0.133**	0.061
Farm size (Number of hectare under rice production)	0.044	0.099	- 0.003	0.023
Soil fertility (Good= 1, Poor= 0)	0.704***	0.201	0.148**	0.063
Access to media (Yes= 1, No= 0)	1.031***	0.228	0.070	0.060
Ownership of mobile phone (Yes= 1, No= 0)	0.700***	0.257	0.057	0.083
Constant	- 4.999***	0.697	0.694***	0.176
Sigma	-	-	0.343***	0.014
Log likelihood	-116.876			-55.319
χ^2	101.04			55.29
N	360			160
Bootstrapping replication	1000			1000

*** Significant at 1%; ** Significant at 5%, and * Significant at 10%.

indicates a test statistic value of 86.245, which exceeds the Chi-square critical value of 22.36 at 5% level of significance. This supports the choice of the double-hurdle model and implies that the decision to adopt improved rice and the area to be planted are governed by separate processes. Overall, the Chi-square statistic was significant (P< 1%) for both adoption and intensity equations. This indicates that, overall, all estimated coefficients were statistically significant. The implication is that all the exogenous variables were pertinent in explaining the likelihood of adoption and intensity of improved rice varieties. Therefore, the model has a good fit with its explanatory variables.

Both adoption decision and area planted to improved rice were positively correlated with education. This implies that farmers that were more educated were more likely to adopt improved rice varieties, and they allocated more land to improved rice. Educated farmers have more ability in collecting information on new technologies than the non-educated farmers. This agrees with the findings of Asfaw *et al.* (2012), Bezu *et al.* (2014), and Ghimire *et al.* (2015), and shows the role of education in adoption of new farm technologies. Experience in rice production was positively associated with the area under improved rice, suggesting that more experienced farmers allocated more land to improved rice. The adoption decision, but not the intensity, was positively correlated with access to extension services and being a member of FBO. These findings suggest that through regular contact with extension agents and farmers' association meetings, the rice farmers could learn about the new technologies. This supports previous findings on farm technology adoption that argue that learning about new technologies may occur through extension services and farmers social interaction (Conley and Udry, 2010; Dandedjrohoun *et al.*, 2012; Asmelash, 2014; Haghjou *et al.*, 2014; Umeh and Chukwu, 2015). Zarafshani *et al.* (2017) suggested that the goal of extension

services should be to reduce the distance to agricultural service centers as well as strengthening contacts with extension officers. Positive relationship was found between participation in market and the probability of adopting improved rice varieties. This suggests that as demand for rice exists, the farmers may be motivated to increase rice supply through the adoption of new technology (Nonvide, 2017). Access to market also facilitates access to information (availability, price, among others) on new technology.

Access to credit was positively associated with both adoption and intensity of improved rice. This suggests that access to credit enables a farmer to purchase farm inputs in time (Beke, 2011; Mdemu *et al.*, 2017; Nonvide *et al.*, 2018). As expected, there was a positive association between participation in off-farm activities and the probability of adoption and intensity of improved rice, implying that income diversification increases a farmer's capacity to afford improved rice technology. The variable soil fertility was positively associated with the likelihood of adopting improved rice varieties and the amount of land under improved rice, suggesting that farmers that perceived their soil as fertile were more likely to adopt improved rice varieties and allocate more land to improved rice than those who perceived their soil as poor. Having a fertile soil is a source of motivation for a farmer to invest more in accessing other farm inputs.

Access to media and ownership of a mobile phone increased the probability of improved rice adoption but did not affect the amount of land to be planted under rice. Similar result was found by Afolami *et al.* (2015). The results imply that information on input and output markets were passed to the farmers through the communication channels (radio, TV and mobile phone). This would create awareness and thus increase the likelihood of adoption of improved rice varieties. The results point out the importance of information in the technology adoption process, suggesting that the

Information and Communication Technologies (ICT) are among the main channels for technology diffusion. The development of information and communication technologies, such as radio, TV, mobile phone and internet, opened up an important opportunity for massive diffusion of agricultural knowledge among farmers. In most developing countries, a high proportion of households own at least a radio, which is one of the fastest channels for communicating agricultural information (Dimelu and Nwonu, 2012).

Conclusions And Policy Recommendation

By using a double-hurdle model, this study analyzed the factors that influence adoption and extent of adoption of improved rice varieties in the municipality of Malanville in Benin. A total of 360 rice farmers were randomly selected for the survey. Results showed that 44 % of the farmers adopted improved rice varieties. Different set of variables affected the decision to adopt improved rice and the area to be planted. The main factors determining the adoption of improved rice varieties in the study area include education, frequency of extension visits, frequency of FBO meetings, access to credit, participation in market, off-farm activities, perception of soil fertility, access to media and ownership of mobile phone. The extent of adoption of improved rice was positively influenced by education, experience in rice production, access to credit, off-farm activities, and soil fertility.

From the findings of this study, we recommend that improved rice varieties should be designed to reflect the farmers' attribute, as they are the potential adopters. The use of information and communication technologies should be facilitated. Given the significant role of extension services and access to credit in the dissemination of improved rice varieties, strong institutional support is needed to promote the improved rice varieties. Therefore, there is a need to provide credit facilities for the rice producers. For better promotion of new rice varieties, there is also a need to facilitate regular contact with extension agents for the farmers.

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شناسایی عوامل موثر بر کاربرد واریته اصلاح‌شده برنج در میان کشاورزان خرده مالک در شهرستان Malanville در بنین

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چکیده

برای بهبود عملکرد برنج در کشور بنین، کاربرد واریته های اصلاح شده برنج ازاهمیت برخوردار است. مطالعه حاضر از یک مدل دو مرحله ای (double-hurdle model) برای ارزیابی عوامل موثر بر پذیرش و کاربرد واریته های اصلاح شده برنج استفاده کرد و از مجموعه داده های مقطعی (cross-sectional dataset) مربوط به ۳۶۰ کشاورز استفاده شد که در شهرستان Malanville در کشوربنین به طور تصادفی انتخاب شده بودند. برآورد مرحله اول چنین اشاره داشت که در شهرستان Malanville، عواملی مانند سطح آموزش، بسآمد و دفعات ملاقات با مروجین، دفعات حضور در جلسه های نهاد های روستایی مبتنی بر کشاورز، دسترسی به اعتبارات، حضور و مشارکت در بازار، فعالیت های خارج از مزرعه، کار برد کود شیمیایی، درک و ارزیابی از حاصلخیزی خاک، دسترسی به رسانه ها، و داشتن تلفن همراه نقش مهم و موثری در فرایند تصمیم گیری در باره پذیرش و کاربرد (این واریته ها) بازی میکند. نتایج مرحله دوم نشان داد که سطح زمین زیر کشت برنج اصلاح شده به طور مثبتی با آموزش، تجربه در برنجکاری، اعتبارات مالی، فعالیت های خارج از مزرعه، و حاصلخیزی خاک همراه است. این نتایج، اقداماتی قوی را در زمینه پشتیبانی نهادی برای ترویج کاربرد واریته های اصلاح شده برنج در بنین توصیه می کند.