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### **Abstract**

**Purpose:** Production and productivity of the agricultural sector in SSA is low due to low technological adoption and techniques among others. One of the major goals of Nigerian agriculture development programs and policies is transition from low productivity subsistence agriculture to a high productivity agro-industrial economy through improved technology adoption.

**Methodology:** A multi-stage sampling technique was used in this study to select 158 rice farming households. The first stage involved the purposive selection of two Agricultural Development programme zones (Ikenne and Abeokuta zones) in the state. The second stage was purposive selection of two blocks per zone based on the concentration of rice farmers. Six farming cells were randomly selected from each block making a total of twenty-four (24) farming community, seven rice farmers were randomly selected from each farming cell giving a sample size of 168 rice farmers. A set of structured questionnaires were used to collect data. Out of the 168-questionnaire administered 158 of it were gotten and used for the study. The data were analysed using descriptive statistics, adoption index, tobit regression model.

**Findings:** Technologies adoption was high among the young farmers than the older farmers. The household size was also a determinant factor of technology adoption. As the household increases in size, there is high probability that all the production technologies will be adopted. Access to credit facility was found to be positive and significant in all the production technologies available to the rice farmers.

**Recommendations:** It was recommended that the young people should be encouraged to modern technologies available for rice production, the farmers should be educated on modern technologies in the production of rice. Credit facilities should be made available for the farm household.

**Keywords:** *Adoption, Rice, Farming, Technology, Tobit*

## 1.0 Introduction

In the Less Developed Countries (LDCs) such as Nigeria and the Sub-Saharan Africa (SSA) at large, economic policy heavily depend on agriculture for poverty reduction and income growth (World Bank Group, 2014). African Development Bank/AfDB (2014), contends that African population living in poverty has fallen larger than 50% in 1981 unlike that of in 2012 which was reduced to 45%. Of which around 48% of the Sub-Saharan countries populations were found under food insecurity. One solution recommended to come up out of this abject poverty is boosting agriculture. However, production and productivity of the agricultural sector in SSA is low due to low technological adoption and techniques among others (Abraham et al., 2014; Berihun et al., 2014; Gashaw et al., 2014; Tsegaye 2012; Lulit et al., 2012; MoFED 2012).

One of the major goals of Nigerian agriculture development programs and policies is transition from low productivity subsistence agriculture to a high productivity agro-industrial economy through improved technology adoption. That is, shift from traditional methods of production to new, science-based methods of production which include new technological components and/or even new farming systems. Solving environmental problems in agriculture requires developing and diffusing new technologies (Viatte, 2001). As huge number of the poor lives in rural areas and are engaged in smallholding agriculture, attempt to address the rural poor are often geared toward improving agricultural practices as a means of increasing productivity, efficiency and, finally income. Agricultural technology aims at increasing agricultural productivity by replacing the old method of farming by a modern and more efficient technique of cultivation (Barla, 2013).

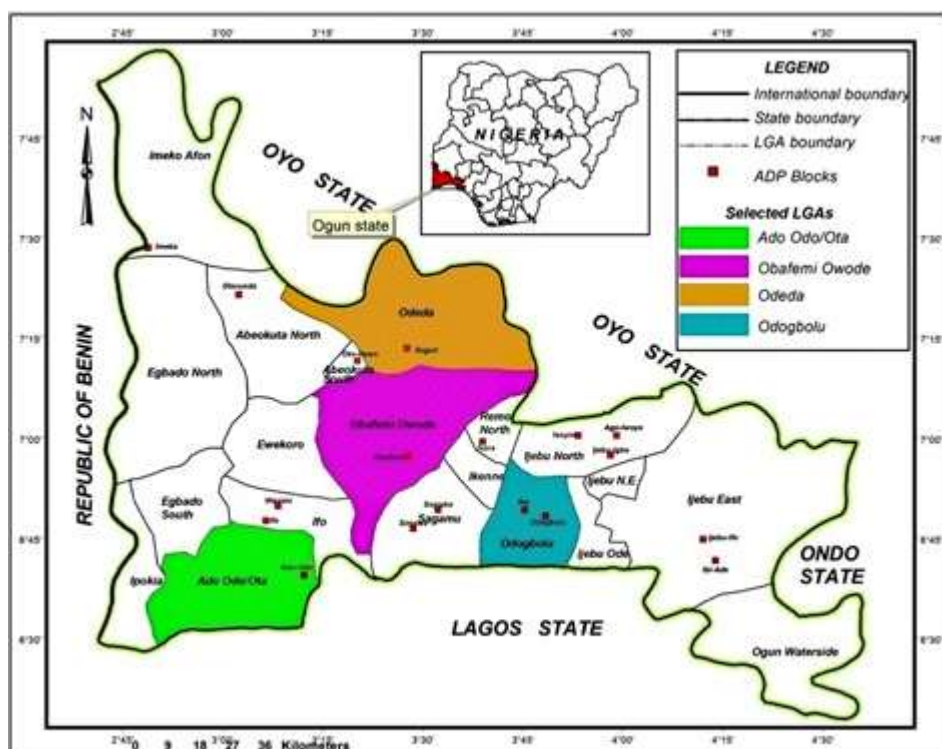
Adoption of improved agricultural technology is a tool needed to improve sustainable agriculture, a way of reconciling the necessity for sustainable and profitable food production, improve productivity and food security. In Nigeria, National Agricultural Research Institutions such as National Cereals Research Institute (NRCI) Badeji, International Institute of Tropical Agriculture (IITA), Universities and other research institutions are in the forefront of developing and applying new technologies. Farmers are now using a number of modern agriculture technologies (crop production/processing/storage/livestock production) for producing more output all over the country (Meena & Punjabi, 2012) and assessment of the adoption of the technologies have moved from just using dichotomous choice to examining the intensity of adoption, addressing the simultaneity of adoption of different components of a technology package, and contextualizing adoption decisions within social, cultural and institutional environments.

## 2.0 Methodology

### 2.1 The Study Area

The study was conducted in Ogun State southwest of Nigeria. It lies between latitude  $6.9075^{\circ}$  N of the equator and longitude  $3.5813^{\circ}$  E of the Greenwich meridian. Ogun State is made up of four (Agricultural Development Programme,) zones, namely; Ilaro zone, Ikenne zone, Abeokuta zone and Ijebu ode zone. The state has a land area of 16,980 sq. km, a population of 3,751,140 people (National Population Commission, 2006). The state has twenty Local Government Area, and the vegetation is evergreen forests and savanna. The major crops are cocoa, oil palm, rice, cassava and cotton.





**Figure 1: Map of Ogun State (Adapted from Afodu et al., 2020)**

## 2.1 Determinants of Technology Adoption and Intensity of Adoption of Technology by Farm Households

Tobit regression model was used to analyze the determinants of adoption index of various specific technology by the respondents. Tobit model is appropriate because respondents may adopt only some part of the recommended package and may also do this on 1% or 100% level. The Tobit model has both discrete and continuous part and it handles both the probability and intensity of adoption at the same time (Augustine & Mulugeta, 2005). In the model, the adoption index was used as the dependent variable. The technologies under study were land clearing, land preparation, improved varieties, herbicide, inorganic fertilizer, organic fertilizer, pesticides, water management, animal tillage and harvester.

The Tobit model applied is specified thus:

$$Ali^* = \alpha_0 + \alpha x_i + \mu_i \dots \dots \dots 1$$

$$Ali = Ali^* \text{ if } \alpha_0 + \alpha x_i + \mu_i > 0 \dots \dots \dots 2$$

$$Ali = 0 \text{ if } \alpha_0 + \alpha x_i + \mu_i < 0 \dots \dots \dots 3$$

Where:

$Ali^*$  = is the latent variable and the solution to utility maximization problem of intensity of adoption subjected to a set of constraints per household and conditional on being above certain limit.

$Ali$  = is adoption index for ith farmer

$X_i$  = Vector of factors affecting adoption. These include household size (HHDSIZ), age of household head (HHAGE), access to credit (CREDIT), Educational status (EDU), farm size (FARMSIZ), Cooperative (Coop), marital status (MARSTAT), sex, extension agent visitation

and farming experience.

$\alpha_i$  = Vector of unknown parameters, and

$U_i$  = is the error term which is normally distributed with mean 0 and variance  $\sigma^2$

**Table 1: Description of the variables specified in the technology adoption model**

Variable	Variable meaning	Types of measure	of A priori expectation with respect to Technology	Source(s)
Household size (HHDSIZ)	Number of adults and children who are resident member	Number	-	Oni, et al; 2011
Age of household head (HHAGE)	Age of the household head	In years	+	Oni, et al; 2011
Access to credit (CREDIT)		Dummy	+	
Educational status (EDU)	Educational level of household head	Number of year of formal education	$\pm$	Sultana and Adiq, 2011
Farm size (FARMSIZ)	Size of agricultural land held by household head	Ha	+	Pankomera, et al; 2009
Sex	Sex of the household head	Dummy (male= 1, otherwise =0)	$\pm$	Adebayo, 2012, Shaikh, 2007

### 3.0 Results and Discussions

#### 3.1 Socioeconomic characteristics

Table 2 shows the socioeconomic characteristics of the farm households in the study area. The age group 36 – 45 years had the highest of percentage of 32.9 which was followed by 26 – 35 years with 27.9 percent, the least was the ages above 56 years which had 13.3 percent. This implies that majority of the farmers in the study area are still in their active age. The results showed that 60.8 percent of the farmers were male while 39.2 percent of them were female. This is in accordance with the study of (Babalola, et al., 2010) which opined that male are more involved in farming work compared to their female counterpart. This may be due to labour intensiveness of farm work. Majority (52.5%) of the farmers household size were between 5 – 8, while 31 percent of the respondents had household size of 1 – 4, while household with 9 persons and above had the least percentage (16%).

Education is an investment in human capital which may be able to raise the qualities of skills of man, narrow his information gaps and increase his allocative efficiency that leads to more productive performance. A large percentage (32.9) of the farmers had no formal education,

while 40.5 percent of them had school cert, 20.3 percent of the farmers had primary education while 6.3 percent of them had tertiary education. It was revealed that most of the farmers (39.9%) had 5-6 hectares of land, followed by those that had 1 – 2 hectares (25.9%) of land, 20.3% of the farmer had 7 hectares and above while farmers with 3 – 4 hectares were the least among them all with 13.9%. Marital status is one of the most important determinant of family labour in the rural area since most of the rural areas are agrarian in nature. The ability of the households to supply the needed labour in the farm depends to a large extent on the marital status of the households.

From table 2 it was observed that majority of the respondents (62.0%) were married, 20.9% of them were single, while 17.1% of them fell into the category of widow/widower. About 72.8 percent of the respondents belongs to one cooperative or the other, while 27.2% of them does not belong to any cooperative society. 46.8% of the farmers had access to credit, while 53.2% of them don't have access to credit facilities. The farmers were mainly (65.2%) Christian, 29.7% were Muslim, while the remaining of them (5.1%) practices other forms of religion. The visit of extension agent is an important factor to educate the farmers on the new and improved technologies on how best farmers can improve his productivity. Most farmers in the study area had extension agent at least once in every two months.

**Table 2: Rice farmers' distribution by socioeconomic characteristics**

<b>Socioeconomic Characteristics</b>	<b>Measure</b>	<b>Frequency</b>	<b>Percent</b>
<b>Age (In Years)</b>	26 – 35	44	27.8
	36 – 45	52	32.9
	46 – 55	41	25.9
	56 and Above	21	13.3
<b>Sex</b>	Male	96	60.8
	Female	62	39.2
<b>Household Size (In Numbers)</b>	1 – 4	49	31.0
	5 – 8	83	52.5
	9 and Above	26	16.5
<b>Educational Status (In Years)</b>	No Primary Education	52	32.9
	Primary Education	32	20.3
	Secondary Education	64	40.5
	Tertiary Education	10	6.3
<b>Farm Size (Ha)</b>	1 – 2	41	25.9
	3 – 4	22	13.9
	5 – 6	63	39.9
	7 and Above	32	20.3
<b>Cooperative Membership</b>	Yes	115	72.8
	No	43	27.2

<b>Access To Credit</b>	Yes	74	46.8
	No	84	53.2
<b>Marital Status</b>	Married	98	62.0
	Single	33	20.9
	Widow	27	17.1
<b>Religion</b>	Christian	103	65.2
	Muslim	47	29.7
	Others	8	5.1
<b>Extension Visit (Number of Visit per Year)</b>	1 – 3	64	40.5
	4 – 6	74	46.8
	7 and Above	20	12.7
<b>Farming Experience (In Years)</b>	1 – 2	18	11.4
	3 – 4	46	29.1
	5 – 6	54	34.2
	7 and Above	40	25.3

*Source: Field survey (2019)*

*Number of observation = 158.*

The result of factors affecting the rate of adoption of some production technology is showed in table 3. A positive significant coefficient in the regression model shows that the corresponding explanatory may increase the adoption rate of the respondents. The various production technologies that were listed include land clearing, land preparation, improved seed, herbicides, organic fertilizer, inorganic fertilizer, pesticides, pest scaring devices, sprayer, and grain harvester.

The coefficient of the age of the farmers was found to be negatively significant land clearing, improved seed, herbicides, and organic fertilizer, which implies that the adoption of these technologies decreases as age increases. That is, the younger the farmer the more likely these technologies will be adopted. This is in conformity with the findings of Ramo, et al. (2009) and Jensen, et al. (2007), which says that younger farmers are more likely to adopt new technology than older farmers. This is in line with the general literature on technology adoption and has been explained by the fact that older farmers usually more reluctant to change. Furthermore, the young farmers are more risk-averse.

The household size (HHS) was observed to be positively significant for some of the production technologies. These are, land clearing, land preparation, herbicides, inorganic fertilizer, pest scaring devices and grain harvester. This implies that as the household increases in size, there is high probability that all these production technologies will be adopted. According to Olumba and Rahji (2014), household size influences farming decision on management practices. The coefficient of educational status was found to be positive and statistically significant in almost all the production technologies. This implies that as the

farmers' level of education increases, the higher the probability of them adopting the production technologies. This is in accordance with the findings of (Faturoti et al., 2008), who emphasized strong positive influence of education on adoption. This reveals that the more the number of years in school, the better the level of adoption of the technologies by the respondents, this is because the more the level of enlightenment, the better the willingness of the farmers to accept farming technologies. The farmers could easily understand the new technologies and are more willing to adopt than their illiterate counterparts.

The farm size of the farmers was found to be significant for all the available production technologies except for pest scaring devices and sprayer technologies, and also organic fertilizer technology was found to be negatively significant. The implication of positively significant farm size on other production technology is that as the farm size increases there is tendency for the farmers to adopt those technologies. This is in line with the finding of Thomas et al. (2017) who found that farmers with large farm size are likely to adopt a new technology as they can afford to devote part of their land to try new technology which when successful would cause them to adopt the technology fully, unlike those with less farm size. This finding also confirms the study by Uaiene et al. (2009) which revealed that farm size influences farmers' adoption of technologies.

Access to credit facility was found to be positively significant in all the production technologies available to the rice farmers. This implies that adoption will increase if farmers have access to credit. This is in conformity with the work of Paudel and Matsuoka (2008) that reported there was a significant positive effect of access to credit on the adoption of improved maize varieties. Beke (2011) found that the coefficient of predicted probability of being credit constrained has a negative and significant effect on the adoption and intensity of improved rice varieties in Ivory Coast. This suggests that credit constraints tend to reduce the adoption of improved agricultural technologies. This implies that farmers should be granted access to more credit to enable them increase the adoption of more technologies. And also, the results of the findings of Simtowe and Zeller (2006) which indicates that access to credit promotes the adoption of risky technologies through relaxation of the liquidity constraint as well as through the boosting of household's risk bearing ability.

Extension agent visits was found to be positively significant on the adoption of land clearing, improved seeds, organic fertilizer, inorganic fertilizer and rice grain harvester. This implies that the frequent the visit the higher the probability of adopting those technologies.



**Table 3: Factors affecting the rate of adoption of some production technology**

Variable	Land clearing	Land preparation	Improved seed	Herbicide	Organic fertilizer	Inorganic fertilizer	Pesticides	Pest scaring devices	Sprayer	Rice harvester
Age	-0.003*	0.013	-0.004**	0.009**	-0.025**	0.277	0.004	-0.009	-0.184	0.218
Sex	-0.017	0.046	-0.011	-0.029	0.004	0.007	0.060	-0.014	0.010	0.002
Hhs	0.021**	0.009**	-0.014	0.003**	-0.061	0.024*	0.011	0.003*	-0.025	0.002**
Edu	0.001**	0.005**	0.016**	0.018**	0.002***	0.006*	0.007***	0.013	0.065	0.010*
Farm Size	0.053**	0.011	0.017***	0.001*	-0.011***	0.014**	0.029**	0.007	0.017	0.062**
Coop	0.036	0.053	0.006	0.010	0.005	0.007	0.055	0.109	-0.014	0.021
Access	0.051*	0.053*	0.041**	0.097*	0.006*	0.039**	0.068**	-0.069**	0.094*	0.023**
Marita	0.032	0.025	-0.048	-0.016	0.053	0.045	0.032	0.025	0.225	0.049
Farmex	0.003	0.032	0.019	0.069	-0.003	-0.019	0.041	-0.031	-0.178	-0.032
Ext. Visit	0.020*	0.011	0.017**	0.005	0.069**	0.048**	0.022	0.215	-0.058	0.033**
Const.	0.757***	0.223**	0.314**	0.427	0.255*	0.377**	0.507**	1.021**	0.628*	0.239**

Field Survey (2019)

Source: Field survey (2019). \*\*\* Significant at 1%, \*\*significant at 5%,

\*significant at 10%. Number of observation = 158

## **4.0 Conclusion and Recommendations**

### **4.1 Conclusion**

The results showed that 60.8 percent of the farmers were male while 39.2 percent of them were female. Educational status was found to be positively significant in all the model. The farmers' level of education was very low because a greater percentage of them had maximum of secondary school certificate. This educational system in study area should be intensified to enable farm households to have the ability to understand modern practices and government policies, so as to take advantage of them. The study also looked at the rice farm household rate of adopting some technologies in cultivation of rice. It was observed that most of the available technologies were not fully adopted. This is an indication that the farmers may not have maximized the utilization of the available technologies. This could be due to lack of awareness or inadequate information on the usage of those technologies. Therefore, educating the farmers on the usage of these technologies will be a benefit to the farmers.

The regression result showed some of the factors that are influencing the adoption of these technologies. The factors include age, household size, education, farm size, access to credit and extension agent visit. The age of farmers showed that younger farmers are more likely to adopt new technologies than older farmers. Therefore, effort should be gear towards young people in the study area. The farmer should be provided with adequate educational facilities since this will enhance their rate of adoption. Access to credit facility has been found to be a pivotal in the adoption of farming technologies implying that farmers should be granted access to more credit to enable them increase the adoption of more technologies. Therefore, the government and other financial institution should create an easy access for rice farmers to financial access.

### **4.2 Recommendations**

The following recommendations were made from the study; 1. The vibrant young people that are willing to go into rice farming should be encouraged by agricultural extension workers to adopt and utilize modern technology available for rice cultivation, 2. Rice farmers should be educated by well-trained agricultural extension workers on modern technologies in the production of rice, 3. Government or private entities should provide credit facilities should be made available for the rice farm household either by the to enhance rice farming activities.

### **References**

- Abraham B, Araya H, Berhe T, Edwards S, Gujja B, Khadka R, Sen D, Koma Y, Sharif A, Styger E, Uphoff N, Verma A. (2014) The system of crop intensification: Reports from the field on improving agricultural production, food security, and resilience to climate change for multiple crops. Addis Ababa, Ethiopia. Available at <http://www.agriculture and food security.com/content/3/1/4>.
- Adebayo, O. O. (2012): Effects of family size on household food security in Osun State, Nigeria. *Asian journal of agriculture and rural development*,. 2(2): 136-14.
- AfDB. African Development Group. Tracking Africa's Progress in Figures. 2014. Analysis study. Addis Ababa, Ethiopia. 2012.
- Augustine, L. & Mulugeta M. (2005): Modeling agricultural technology adoption using the software STATA, training manual presented at a training course organized by CIMMYT-ALP Harare Zimbabwe.

- Babalola, DA, Makinde Y O and Afodu, J O. (2010): 'Nutrition Transition and Indicators of Hypertension among Farming Households in Nigeria: Evidence From Ikenne Local Government Area of Ogun State'. *Canadian Journal of Pure and Applied Science*. 5(1), 1349-1353.
- Barla, M. (2013): The impact of new agricultural technology on tribal farming: a study of Ranchi District of Jharkhand State. *Journal of Economic & Social Development*. 9; 121-131.
- Beke T.E. (2011): Institutional Constraints and Adoption of Improved Rice Varieties: Econometrics Evidence from Ivory Coast. *Rev. Agric. Environ. Stud.* 92(2): 117-141
- Berihun KH, Bihon KA, Kibrom AW. (2014): Adoption and impact of agricultural technologies on farm income: evidence from Southern Tigray, Northern Ethiopia. *Int. J. Food Agric. Econ.* 2(4):91-106
- Faturoti B.O., Agwu A. E., Igbokwe E. M. and Tenkouano A. (2008): 'International Institute of Tropical Agriculture plantain and banana programme: An insight into the contributions of farmer-to- farmer extension paradigm.' *African Journal of Biotechnology*. 7 (13), 2137-2146.
- Gashaw T, Alan B, Nicholas M, Tanguy B. (2014): The impact of the use of new technologies on farmers wheat yield in Ethiopia. International Food Policy Research Institute (IFPRI).. Washington, DC
- Jensen K., Clark C.D., Ellis P., English B., Menard J., Walsh M., de la Torre U.D. (2007): Farmer Willingness to Grow Switch Grass for Energy Production. *Bioma. Bioener.* 31 (11-12): 773-781
- Lulit M, Ermias E, Zelalem H. (2012): Public investment in irrigation and training for an agriculture-led development: a CGE approach for Ethiopia. Addis Ababa, Ethiopia. .
- Meena, G. L. & Punjabi N. K. (2012). Farmer's perception towards agriculture technology in tribal region of Rajasthan. *Rajasthan Journal of Extension Education*, 2012; 20: 92-96.
- National Population Commission. (2006): National Census Report, National Population Commission, Abuja, Nigeria.
- Olumba, C.C. and Rahji, M. A.Y. (2014): 'An Analysis of the Determinants of the Adoption of Improved Plantain Technologies in Anambra State, Nigeria.' *Journal of Agriculture and Sustainability*. (2): 232-245.
- Oni, O.A., K. K. Salman and B.O. Idowu. (2011). "Social capital dimension and food security of farming households in Ogun State, Nigeria." *Journal of American Science*, 7(8): 776-783.
- Pankomera P, Houssou N, Zeller M. (2009): Household food security in Malawi: measurements, determinants and policy review. Conference on International Research on Food Security, Natural Resource Management and Rural Development, University of Hamburg, Tropentag, Hamburg.
- Paudel P. and Matsuoka A. (2008): Factors Influencing Adoption of Improved Maize Varieties in Nepal: A case study of Chitwan District. *Aust. J. Bas. Appl. Sci.* 2(4): 823-834.

- Ramo A.K., Jarvinen E., Latvala T., Toivonen R. and Silvennoinen H. (2009): Interest in Energy Wood and Energy Crop Production Among Finnish Non-Industrial Private Forest Owners. *Bioma. Bioener.* 33(9): 1251-1257
- Shaikh, F. M. (2007): Determinants of Household Food Security and Consumption Pattern in Rural Sindh: Non-Separable Agriculture Household Model. *IUB Journal of Social Sciences and Humanities.* 5(2): 18-39.
- Simtowe, F., and Zeller, M. (2006): The Impact of Access to Credit on the Adoption of hybrid maize in Malawi: An Empirical test of an Agricultural Household Model under credit market failure.
- Sultana Anila and Adiq Kiani. (2011): Determinants of food security at household level in Pakistan. *African Journal of Business Management.* 5(34): 12972- 12979,
- Thomas Bilaliib Udimal Zhuang Jincui, Owusu Samuel Mensah and Ayamba Emmanuel Caesar. (2017): 'Factors Influencing the Agricultural Technology Adoption: The Case of Improved Rice Varieties (Nerica) in the Northern Region, Ghana.' *Journal Economics and Sustainable Development.* 2017; 8(8).
- Tsegaye, M. (2012): Vulnerability, Land, Livelihoods and Migration Nexus in Rural Ethiopia: A Case Study in South Gondar Zone of Amhara Regional State. International institute of social studies, Hague, Netherlands.
- Uaiene, R. N., Arndt, C., and Masters, W. (2009): Determinants of agricultural technology adoption in Mozambique. Discussion papers, 67.
- Viatte G. (2001): Adopting technologies for sustainable farming systems: an OECD perspective. In Proceedings of Adoption of Technologies for Sustainable Farming Systems Wageningen Workshop. 21p. OECD Publications, Paris Cedex.
- World Bank Group (2014). Ethiopia poverty assessment. Document of the WB for official use only.