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Adoption of improved agricultural technologies for Irish potatoes (*Solanum tuberosum*) among farmers in Mbeya Rural district, Tanzania: A case of Ilungu ward

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1 SUMMARY

This study was carried out in Ilungu ward Mbeya Rural district, Tanzania to assess adoption of improved agricultural technologies for Irish potatoes (*Solanum tuberosum*) among farmers. Specific objectives were identification of improved agricultural technologies for Irish potatoes farming disseminated in the area; to determine extent of adoption of these technologies; and identification of factors influencing adoption. Study design was a cross-sectional survey in two randomly selected villages from the ward in which 60 households were involved. Quantitative data from household heads were collected in the area using a structured questionnaire. In-depth interviews with extension officers were also carried out to obtain relevant data for the study. Results indicate that a range of improved agricultural technologies (eight technologies) have been disseminated in the area by extension agents. Extent of adoption among farmers varied with type of technology. Seeding rate, timely sowing and fungicide application were the highly adopted technologies. Each of these technologies was adopted by at least 80% of surveyed households. Improved varieties and pesticide application were used by 58% and 51% of the surveyed households, respectively and hence moderately adopted technologies. Least adopted technologies were recommended chemical fertilizer application rate as well as folial/booster fertilizer application which were used by nearly one- third of surveyed households, and recommended spacing which was not used by any of the surveyed households. Assessed by number of technologies adopted (overall adoption), results indicate half of surveyed households to have adopted not more than three out of eight of improved agricultural technologies for Irish potatoes disseminated in the area, reflecting poor overall adoption by a significant portion of surveyed households. Results for Multiple Linear Regression Analysis indicated that increased household income, being a male or married by a household head, increased farming experience, access to credit and extension services were positively and significantly associated with overall adoption. Based on these results recommendations for improving adoption have been indicated.

2 INTRODUCTION

High incidences of poverty and poor living standards have been some of the major development challenges in Mbeya rural district in Southern highlands zone of Tanzania (SHZ).Statistics show that in the year 2001 nearly one-third of the population in the area was living below poverty line (URT, 2005). However, Mbeya rural district has relatively good climatic conditions that favor production of various types of crops, though agricultural

activities in the area are characterized by smallholder production systems as the major means of livelihood (URT, 1997; Mwankemwa, 2004; URT, 2006; Sokoni, 2007). Irish potatoes (*Solanum tuberosum*) are one of the widely grown crops in Mbeya rural district for both food and cash (Andersson, 1996; URT, 1997; Kabungo, 2008). The district has been one of the main producers of Irish potatoes in Southern Highlands of Tanzania, and in a country as a whole. Southern highlands of Tanzania, particularly Mbeya rural district is the highest producers of Irish potatoes in the country (58% of total production) and large volume of supply of Irish potatoes in markets in others regions of Tanzania is from the area (Andersson, 1996; MOAC, 2001; URT, 2003; Kabungo, 2008).

Although large volume of Irish potatoes production in the country is from Mbeya rural District, studies indicate that production of this crop in the area has not been to its full potential. A study by Kabungo (2008) in Mbeya rural district revealed average yield per acre for this crop to be nearly 5 tons, instead of 25 tons under optimal agronomic practices (Kanyeka *et al*., 2007; Al-Dalain, 2009). Therefore, there is still an opportunity for increased production for this crop in area and hence poverty reduction through use of improved agricultural technologies. Similar to other crops, for several years (more than 20 years) Agricultural Research Institute of Uyole (ARI-Uyole) has been engaged in generation improved agricultural technologies for round potatoes farming for use by farmers in southern highlands of Tanzania including farmers in a study area to enhance productivity. This has been through various programmes such as Tanzania Agricultural Research Project (TARP). The Research institute has also been working very closely with agricultural extension system and other stakeholders in the area in trying to disseminate these technologies to farmers (Kanyeka *et al*., 2007). However, despite of the efforts done, there is dearth of information on the adoption of the disseminated technologies and factors hindering or promoting their adoption, information important for more informed decisions and programmes aiming at improving round potatoes production in the study area. Therefore, this study was carried out to fill this information gap.

3 METHODOLOGY

3.1 Study area: This study was carried out in Ilungu ward in Mbeya rural district, Southern Highlands of Tanzania. The District is one of seven districts of Mbeya region. The district lies between latitude 8° 58' to 9° S and between longitude 33° 43'to 33 47' E, (URT, 1997). The district lies at an altitude ranging from 1000 - 2400 meters above sea level. The average temperature ranges between 12^{o}C and 30^{o} C annually. Mean annual rainfall ranges from 650mm and 2700mm. Based on Population and Housing Census of 2002, Mbeya Rural district has a population of 254,897.

Main economic activities in the area include both crop and livestock production. Some of the major crops grown in the area include Maize, Irish potatoes, Coffee, Banana, Wheat, Beans, Cassava, Groundnuts, vegetables (Tomato, Onion, Cabbage) Millets, Sunflower, Pyrethrum, and cotton. Irish potatoes and Coffee are the leading cash crops (URT, 1997). The study involved two villages namely Shango and Kikondo, out of seven randomly selected from Ilungu ward). Ilungu ward was purposively selected for study as it is among the leading ward in Irish potatoes production in the District.

3.2 Study design: This study involved a cross-sectional survey in two villages randomly selected from the area. The survey was conducted between June to August, 2009. In each village 30 households were randomly selected for the study making a total number of household involved in the study being 60. Data from households were collected using a pre-tested structured questionnaire. Heads of households were purposively involved in the study because they are at the hub of decision making at the household level (Kisinza *et al*., 2008). A questionnaire was designed to gather information on socio-economic and demographic characteristics

of a household/household head, farm size and farming experience, improved agricultural technologies for Irish potatoes farming adopted access to extension and credit services, membership to organizations and perceived market for Irish potatoes. In addition, in-depth interviews with extension officers were also carried to identify improved agricultural technologies for Irish potatoes disseminated in the study area.

3.3 Data analysis: Data collected were verified, coded and then analyzed for descriptive statistics such means, frequencies and percentages using Statistical Package for Social Sciences (SPSS) program. The program was further used for running a multiple linear regression analysis for isolating factors influencing adoption of improved agricultural technologies for Irish potatoes farming in the study area. In regression analysis, number of technologies adopted by a farmer was used as a dependent variable (Y) as applied in a study by Agwu *et al.* (2008), and independent variable included variables such as education level of household head (X_1), Age of household head (X_2), annual household income (X_3), sex of household head (X_4), marital status (X_5), household size (X_6), farm size (X_7), experience in Irish potatoes farming (X_8), accessibility to extension services (X_9), accessibility to credit services (X_{10}), membership to organization/Social capital (X_{11}), perceived market for Irish potatoes (X_{12}) and distance from market centre (X_{13}). These are shown in the equation 1. Details for all variables involved in regression analysis and their expected effect as per literature are indicated in Table 1.

$$Y = f\left(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, X_{12}, X_{13}\right) \ldots\ldots..1$$

Table 1: Variables for regression analysis

Variables	Description	Expected effect (sign)
Dependent variable:		
Adoption (Y)	Number of technologies adopted	
Independent variables:		
Education (X_1)	Education level of household head (Years in school)	+
Age (X_2)	Age of household head (years)	+/-
Income (X_3)	Annual household income in Tsh. (Dummy: 1 if ≥ 650,000 (i.e. equal or above mean; 0 if otherwise)	+
Sex (X_4)	Sex of household head (Dummy: 1 if Male; 0 if otherwise)	+
Mstatus (X_5)	Marital status by household head (X_5) (Dummy: 1 if Married; 0 if otherwise)	+/-
Hsize (X_6)	Household size (Number of individuals in a household)	+
Fsize (X_7)	Farm size (acres)	+
Experience (X_8)	Number of years engaged in Irish potatoes farming	+
Extension(X_9)	Access to extension services (Dummy: 1 if Yes; 0 if otherwise)	+
Credit (X_{10})	Access to credit (Receipt of credit) (Dummy: 1 if Yes; 0 if otherwise)	+
Membership(X_{11})	Membership to organization (farmers group)/social capital (Dummy: 1 if Yes; 0 if otherwise)	+
Market(X_{12})	Perception on the market for Irish potatoes (Dummy: 1 if good; 0 otherwise)	+
Distance (X_{13})	Distance to market centre in km (a proxy indicator for access to farm inputs)	-

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4 RESULTS AND DISCUSSION

4.1 Characteristics of respondents: Socio-demographic characteristics of respondents are shown in Table 2. Most of the respondents were married (70%) and about two-third of them (68%) were males, indicating most of the households were headed by men. Patriarchy system and male dominance in decision making for many African societies have resulted into most of households being lead by men (Duze and Mohammed, 2006; Kisinza *et al*., 2008). Majority of respondents (more than 60%) had the age between 30 - 50 years, indicating that most of the respondents were of the middle age, the age at which they are still energetic and hence can actively involve in production activities (Lupilya, 2007). Moreover, most of the respondents (>85%) had at least primary education, and indication that there was a good literacy level in the area and hence expecting reasonably good ability to process information (i.e. agricultural extension packages) by majority of respondents as it has been observed in other studies (Deshmukh *et al*., 2007; Junge *et al*., 2009) . Household size by majority of respondents (65%) was between 5- 10 members with average of 5.2, which is close to national average of 4.9 (THBS, 2001), implying that they have enough costless labour for farm activities (Okoedo-Okojie and Onemolease, 2009). In this study, respondents were also asked to indicate the estimate of their annual household income. Results indicate that annual household income by nearly two-third of the respondent's lies between Tanzanian shillings (Tsh) 500,000 to 750,000 (approximately 345 to 517 US $) with average of Tsh. 650,000 (i.e. 448 US $)

Table 2: Socio- economic characteristics of respondents (n= 60)

Variable	Frequency	Percent
Marital status		
Married	42	70.0
Single/widow	18	30.0
Age (years)		
< 30	14	23.3
30 -40	27	45.0
40-50	14	23.3
> 50	5	8.3
Mean ± SD	41 ± 7.9	
Sex		
Male	41	68.3
Female	19	31.7
Education level		
None	4	6.7
Primary	51	85.0
Secondary and higher	5	8.3
Household size (No.)		
< 5	15	25.0
5-10	39	65.0
> 10	6	10.0
Mean ± SD	5.2 ± 2.3	
Annual household income (Tsh.)		
<500,000	6	10.0
500,000 – 750,000	39	65.0
> 750,000	15	25.0
Mean ± SD	650,000 ± 310,000	

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4.2 Information related to Irish potatoes farming by surveyed households: Results from Table 3 shows that most of the respondents had at least 10 years of experience in Irish potatoes farming. Average land size under Irish potatoes farming was about 2 acres which accounts for 45% of total farm size. These observations indicates that farmers in the areas are heavily engage in Irish potatoes farming and a significant portion of land has been devoted for Irish potatoes farming, reflecting the importance of this crop for their livelihood. A study by Kabungo (2008) reported similar observations in other parts of Mbeya rural district. About 52% of the respondents indicated to be readily accessible to extension services, while 37% said that they were accessible to credit services. These observations indicate low accessibility to extension and credit services by a significant proportion of farmers in the area. Lack of accessibility to extension and credit services have been reported in many parts of Sub-Saharan Africa as well as other developing countries as the limiting factor for increased agricultural productivity (Eze *et al*., 2006; Junge *et al*, 2009; Okoedo-Okojie and Onemolease, 2009). When asked how they perceive market for Irish potatoes farming, an item thought to be an incentive for increased production and consequently adoption of improved technologies (Yohannes *et al*., 1993), nearly half (45%) of the respondents were of the opinion that market for Irish potatoes is good, reflecting good market for this crop from the area. Although membership to organization (i.e. Cooperative membership) is considered as important information source including farming among farmers (Salasya *et al.,* 2007; Agwu *et al*., 2008; Odoemenem and Obinne, 2010) results from this study revealed that only 28% of the respondents were members of organizations (i.e. farmers groups). This information shows that the potential of social-network (social capital) through farmers group as source of agricultural related information has not been fully utilized in the area. Results from Table 3 further shows that average distance to market centre by a farmer, a proxy indicator for access to farm inputs (Salasya *et al*., 2007), was 5 km, indicating most farmers in the area are not too far from market centers and hence have reasonably good access to farm inputs.

Table 3: Information related to Irish potatoes farming activities by respondents (n = 60)

Variable	Value
Years of farming experience in Irish potatoes farming (% ≥ 10 years)	63
Cropping land(farm size) in acreages (Mean ± SD)	4.2 ± 2.3
Cropping land under Irish potatoes farming in acreages (Mean ± SD)	1.9 ± 1.2
Access to extension services (% Yes)	52
Access to credit (% Yes)	37
Membership to organization i.e. farmers groups (%Yes)	28
Distance to market centre in km (a proxy indicator to access to inputs) (Mean ± SD)	5 ± 3.2
Perceived market for Irish potatoes (% responded good)	45

4.3 Types of improved agricultural technologies for Irish potatoes disseminated in the area and their adoption: Agricultural Research Institute of Uyole (ARI-Uyole) is a research institute mandated for development of improved agricultural technologies for the use in Southern Highlands of Tanzania (Kanyeka *et al*., 2007). About eight (8) improved agricultural technologies for Irish potatoes farming recommended in the area by ARI- Uyole and were found to have been disseminated in the area by local extension agents and other stakeholders. These technologies include improved varieties such as *Kikondo* (CIP 720050), *Bulongwa*, *Sesamua*, *Baraka* and *Malawi*; Chemical fertilizer application at the rate of 150kg per acre; Folial fertilizers-NPK application (booster); Insecticides such as Thionex, Selecrone, Sumithion and Karete; Fungicides such Ridomil, Blue copper, Red copper, Brava, and Kocide; Plant spacing of 30cm by 60cm; seed rate of 8 to 10 bags of 100 kg per acre; and timely sowing i.e. from August to November and then from March to May. Proportions of surveyed households adopted these technologies are indicated in Table 4. Seeding rate, timely sowing and fungicide application were the highly adopted technologies; about 92%, 100% and 80% of respondents indicated to have adopted these

technologies, respectively. Improved varieties and pesticide application were moderately adopted technologies. These technologies were used by 58% and 51% of the surveyed households, respectively. Recommended chemical fertilizer application rate as well as folial/booster fertilizer application, together with recommended spacing were the least adopted technologies. While none of the surveyed households adopted the recommended spacing rate, the other two technologies were adopted by only nearly one- third of the surveyed households (Table 4). Furthermore, when data analyzed by number of technologies adopted (i.e. overall adoption) (Agwu *et al*., 2008), it was noted that a significant portion of respondents (50%) had adopted not more than three technologies out of eight (Table 5). Therefore, it is evident that several technologies for improved agricultural technologies for Irish potatoes farming are available in the area. However, extent of adoption of most of these technologies and total number of technologies adopted (overall adoption) is not satisfactory. This trend is responsible for the existing low productivity per acre for this crop in the area observed in previous studies (Kabungo, 2008). It is well known that in sub-Saharan Africa low agricultural productivity by small scale farmers, among other to have been contributed by poor adoption of improved agricultural technologies. Therefore, identification of factors hindering adoption/uptake of improved agricultural technologies has been an important research agenda in the area (Salasya *et al*., 2007; Omoregbee and Okoedo-Okojie 2008; Okoedo-Okojie and Onemolease, 2009; Odoemenem and Obinne, 2010).

Table 4: Technologies for Irish potatoes farming available in the area and their adoption status by respondents (n = 60)

Type of improved technologies	Number of surveyed farmers adopted
Improved varieties	35(58.3%)
Chemical Fertilizers- 150kg per acre	16(26.7%)
Folial fertilizers- NPK (booster)	18(30.0%)
Fungicides	48(80.0%)
Insecticides	31(51.7%)
Seed rate of 8 to 10 bags of 100kg per acre	55(91.7%)
Spacing (30cm by 60cm)	0(0.0%)
Timely sowing	60(100.0%)

Table 5: Distribution of respondents by number of improved agricultural technologies for Irish potatoes adopted

Number of technologies adopted	Frequency	Percent
≤ 3	30	50.0
4-5	17	28.3
6-7	13	21.7

4.4 Factors influencing adoption of improved agricultural technologies for Irish potatoes: Multiple linear regression analysis was also carried out to identify factors influencing adoption of improved agricultural technologies for Irish potatoes in the study area. Results from Table 6 indicate that although the sign of all coefficients were on the expected direction, only some variables were found to be significantly associated with the number of technologies adopted. Increased household income was significantly positively associated with adoption of improved technologies (i.e. number of technologies adopted). Similar findings have been reported in several studies. Franzel (1999) argued that higher income farmers may be less risk averse, have more access to information, have longer-term planning horizon, and have greater capacity to mobilize resources and hence increased likelihood of adopting new technologies. Being a male or married by a household head were significantly positively associated with adoption of improved technologies.

Cultural settings of most African societies have always being favoring males to be more dominant and acquiring more resources than females and hence having relatively higher income (Keele *et al*., 2005; Duze and Mohammed, 2006). As it has already been observed in the present study, increased income is strong drive for adoption of improved agricultural technologies. This observation support earlier findings with regard to adoption of improved agricultural technologies reported elsewhere in Africa (Due and Gladwin, 1991; Quisumbing, 1996). Positive association between marriage and adoption of improved technologies could be attributed the desire to meet increased household needs as a result of marriage by increasing production. Voh *et al.* (2001) asserted that a married farmer is more likely to adopt improved agricultural technologies as he/she need to feed more mouths.

Other variables that were significantly positively associated with adoption of technologies were increased farming experience, access to extension services and access to credit services (receipt of credit) (Table 6). These findings agree with a number reports on adoption of improved agricultural technologies by small scale farmers (Adesina and Baidu-Forson, 1995; Saka *et.al*., 2005; Eze *et al*., 2006; Junge *et al*, 2009; Okoedo-Okojie and Onemolease, 2009; Odoemenem and Obinne, 2010). Experience enrich the farmer on the major production aspects such as a sound knowledge of agronomic practices; Regular contact with extension agents make farmers being aware of new technologies and how they can be applied, and access to credits enable them to buy inputs required by improved technologies.

Effect of education, age, household size, farm size, membership to organization, perceived market for Irish potatoes and distance to market centre were not significant (Table 6), indicating that they were not important predictors of adoption of improved technologies in the study area. These observations contradict some findings reported in several studies (Saka *et al*., 2005; Salasya *et al*., 2007;Omoregbee and Okoedo-Okojie 2008; Okoedo-Okojie and Onemolease, 2009; Odoemenem and Obinne, 2010), in which these factors were found to be important. This reflects the importance of contextual specific (i.e. type of technology and location) factors for adoption. Therefore, factors for adoption for improved agricultural technologies should not be generalized.

Table 6: Multiple Linear Regression analysis for factors influencing adoption of improved agricultural technologies for Irish potatoes farming with dependent variable being number of technologies adopted

Independent variables	Unstandardized Coefficients		Standardized Coefficients	t-value
	B	Std. Error	Beta	
(Constant)	0.164	0.826		0.198
Education(X_1)	0.006	0.021	0.008	0.303
Age (X_2)	0.008	0.031	0.040	0.263
Income (X_3)	0.471	0.178	0.102	2.640*
Sex (X_4)	0.527	0.143	0.120	3.670**
Mstatus (X_5)	0.427	0.169	0.095	2.524*
Hsize (X_6)	0.063	0.057	0.095	1.112
Fsize (X_7)	0.043	0.054	0.040	0.791
Experience (X_8)	0.102	0.045	0.162	2.257*
Extension (X_9)	0.892	0.171	0.219	5.233***
Credit (X_{10})	0.779	0.198	0.185	3.944***
Membership(X_{11})	0.283	0.169	0.063	1.675
Market (X_{12})	0.018	0.096	0.004	0.187
Distance (X_{13})	-0.022	0.033	-0.045	-0.654

R^2 = 0. 76; *, ** and *** = Significant at $P < 0.05$, $P < 0.01$ and $P < 0.001$, respectively

5 CONCLUSION AND RECOMMENDATIONS

A range of improved agricultural technologies have been disseminated in the area. However, extent of adoption of some technologies (i.e. chemical fertilizer application and plant spacing) and total number of technologies adopted (overall adoption) were generally low. Increased household income, being a male or married by a household head, increased farming experience, access to credit and extension services were positively and significantly associated with adoption of improved agricultural technologies (number of technologies adopted) for Irish potatoes. In this regard, therefore, for improved adoption of agricultural technologies for Irish potatoes it is recommended that access to credit services by small scale farmers engaged Irish potatoes farming in the study area should be strengthened. Since being female by a household head lessened adoption, mainly due to limited household resource, therefore, special consideration for agricultural credits should be given to women. Agricultural extension services in the area should be improved so as to address varied needs of majority of farmers. Furthermore, since adoption was also positively associated with experience, extension personnel should not only concentrate with more experienced farmers, they should also work closely with new and less experienced farmers so as to stimulate more adoption of technologies in the area.

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7 REFERENCES

Adesina AA. and Baidu-Forson J: 1995. Farmers' perceptions and adoption of new agricultural technology: evidence from analysis in Burkina Faso and guinea, West Africa. Agricultural Economics 13:1-9.

Agwu AE, Ekwueme JN. and Anyanwu AC: 2008. Adoption of improved agricultural technologies disseminated via radio farmer programme by farmers in Enugu State, Nigeria. African Journal of Biotechnology. 9: 1277- 1286.

Al-Dalain SA: 2009. Effect of intercropping of Zea maize with potato Solanum tuberosum, L. on potato growth and on the productivity and land equivalent ratio of potato and Zae maize. Agricultural Journal 4(3): 164-170.

Andersson JA: 1996. Potato cultivation in the Uporota Mountains, Tanzania: An analysis of the social nature of agro-technological change. African Affairs. 95: 85- 106.

Deshmukh PR, Kadam RP. and Shinde VM: 2007. Knowledge and adoption of agricultural technologies in Maradhawa. Indian Res. J. Extn Edu. 7(1): 41-43.

Due JM. and Gladwin C: 1991. Impacts of Structural Adjustment Programs on African Women Farmers and Female-Headed Households. American Journal of Agricultural Economics: 1431-1439.

Duze M. and Mohamed ZI: 2006. Male Knowledge, Attitudes, and Family Planning Practices in Northern Nigeria. African Journal of Reproductive Health. 10 (3): 53-65.

Eze CC, Ibekwe UC, Onoh PO. and Nwajiuba CU: 2006. Determinants of adoption of improved cassava production technologies among farmers in Enugu State of Nigeria. Global Approaches to Extension Practice. 2 (1): 37-44.

Franzel S: 1999. Socio-economic factors affecting the adoption potential of improved tree fallows in Africa. Agroforestry Systems 47: 305- 321.

Junge B, Deji O, Abaidoo R, Chikoye D. and Stahr K: 2009. Farmers' Adoption of Soil Conservation Technologies: A Case Study from Osun State, Nigeria. The Journal of Agricultural education and extension.15(3): 257- 274.

Kabungo CVD: 2008. Evaluation of Irish Potato production and marketing performance: A case study of Mbeya Rural District, Mbeya Region, Tanzania. Msc. Dissertation, Sokoine University of Agriculture, Morogoro, Tanzania. 89pp.

Kanyeka E, Kamala R. and Kasuga R: 2007. Improved agricultural technologies recommended in Tanzania. First Edition. 141pp.

Keele JJ, Forste R. and Flake DF: 2005. Hearing Native Voices: Contraceptive Use in Matemwe Village, East Africa. African Journal of Reproductive Health. 9 (1): 32-41.

Lupilya GS: 2007. Assessment of social support projects for vulnerable groups towards poverty reduction: A case study of TASAF in Bukoba district. M.A Dissertation, Sokoine University of Agriculture, Morogoro, Tanzania. 112 pp.

MOAC: 2001. Ministry of Agriculture and Cooperatvies- Basic data annual report. Dar-es-salaam, Tanzania.

Mwankemwa ASA: 2004. Performance of saving and credit co-operative societies and their impact on rural livelihoods: A case study of Morogoro rural and Mvomero districts, Tanzania. Msc. Dissertation, Sokoine University of Agriculture, Morogoro, Tanzania. 132pp.

Odoemenen IU. and Obinne CPO: 2010. Assessing the factors influencing the utilization of improved cereal crop production technologies by small-scale farmers in Nigeria. Indian Journal of Science and Technology. 3(1): 180-183.

Okoedo-Okojie DU. and Onemolease EA: 2009. Factors affecting the adoption of yam storage technologies in the Northern Ecological zone of Edo State, Nigeria. Journal of Human Ecology 27(2): 155-160.

Omoregbee F. and Okoedo-Okojie DU: 2008. Farmers' characteristics and adoption of recommended practices under the Fadama Project Scheme in Edo State, Nigeria. Global Journal of Agricultural Sciences. 7 (1): 45-48.

Quisumbing AR: 1996. Gender differences in agricultural productivity: methodological issues and empirical evidence. Economic Development and Cultural Change 24: 1579-1596.

Saka JO, Okoruwa VO, Lawal BO. and Ajijola S: 2005. Adoption of Improved Rice Varieties among Small-Holder Farmers in South-Western Nigeria. World Journal of Agricultural Sciences 1 (1): 42-49.

Salasya B, Mwangi W, Mwabu D. and Diallo A: 2007. Factors influencing adoption of stress-tolerant maize hybrid (WH 502) in Western Kenya. African Journal of Agricultural Research. 2(10): 544-551.

Sokoni CH: 2007. Commercialization of Smallholder Production in Tanzania: Implications to Sustainable Resource Management. Paper presented at the workshop on Resource Management and Sustainable Development Held on August 13th–17th 2007, Dar es Salaam, Tanzania.

THBS: 2001. Tanzania Household Budget Survey. National Bureau of Statistics, Dar-es-salaam.

URT: 1997. United Republic of Tanzania. Mbeya District Socio-Economic Profile. 129pp.

URT: 2003. United Republic of Tanzania. Mbeya Region Socio-Economic Profile. 195pp.

URT: 2005. United Republic of Tanzania. Poverty and Human Development Report. 108pp.

URT: 2006. United Republic of Tanzania. Agricultural Sector Development Programme (ASDP). Support through Basket Fund. Government Programme Document.

Voh JP, Ahmed B, Olufajo S, Dike M. and Ishaku F: 2001. Adoption of improved cowpea technologies in the savanna ecology of Nigeria. A report of survey conducted on PEDUNE/PRONAF project in Nigeria by Institute for Agricultural Research, Ahmadu Bello University Samaru .- Zaria, Nigeria.

Yohannes M, John G. and Garth C: 1993. Strategic Decision-Making: Adoption of Agricultural Technologies and Risk in a Peasant Economy. http://mpra.ub.uni-muenchen.de/387/.