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An Assessment on Effect of Adoption of Small Scale Irrigation Technologies by Fadama Users in Agricultural Zone III of Niger State, Nigeria

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Author's contribution

This work was carried out by author MU as a sole author. It was also designed and coordinated by author MU collected samples and produced the draft by the sole author. The sole author which is author MU read and approved the final manuscript.

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ABSTRACT

The Study examined an assessment on effect of adoption of small scale irrigation technologies by fadama users in agricultural zone III of Niger state, Nigeria. The broad objective of the study was to examine an assessment on effect of adoption of small scale irrigation technologies by fadama users in agricultural zone III of Niger state, Nigeria. The specific objectives were to examine the effects of small scale irrigation technologies on the crop output yield, to identify factors influencing the adoption of small-scale irrigation technology by the farmers; to identify constraints of small–scale irrigation technologies in the study area; Data were obtained by the use of structured questionnaire that were administered to 180 respondents. Descriptive statistics and multiple regression were statistical tools used to analyze the data. Findings show that 74.4% of the respondents report a significant increase in the quantity of crop and 23.9% report an average increase in the quantity of crops this implies that with the adoption of small scale irrigation technology the quantity of crop production increase thereby making them to have more products to take to the market and more to eat or feed on. The study found out that labour and cost of

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maintenance are constraint to adoption of small scale irrigation technology. It's therefore recommended that small scale irrigation technology with little cost of maintenance and low labour requirement should be introduce to the farmers.

Keywords: Agronomic and economic constraints; effect on living standard; small-scale irrigation; Fadama farmers.

1. INTRODUCTION

Irrigation is the science of artificial application of water to the land or soil. It is used to assist in the growing of agricultural crops, maintenance of land scape and re-vegetation of disturbed soils in dry areas and during periods of inadequate rainfall. [1] Irrigation farming is one of the most important rural development investments that can have both direct and indirect impacts on poverty and food security.

Small-scale irrigation technology is irrigation on small plots under the control of farmers, using technology they can effectively operate and maintain [2]. In small-scale irrigation the fadama users have the controlling influence, using a level of technology which they can operate and maintain effectively. Small-scale irrigation is, farmer-managed, farmers must be involved in the design, process and in particular, with decisions about boundaries, the layout of the canals, and the position of outlets and bridges. Irrigation plays a key role in the performance of agriculture, which increases income growth and livelihood of the fadama users.

Fadama is a Hausa language word which means wetland. Fadama are regarded as rich agricultural areas that contain land and water resources that could easily be developed for irrigation agriculture, [3]. [4] defined Fadama as river valley areas which are seasonally flooded or have high water tables for all, or a large part of the year. The National Fadama Development Program (NFDP) was designed to assist some States of the Federation through the World Bank supported Agricultural Development Projects (ADP) network to among others: Finance the provision of shallow tube wells in Fadama lands for small scale irrigation, [5] stated that Fadama project is aim at further encouraging small scale irrigation schemes that could be adaptable for all Fadama Areas. This will double the cropping intensity and make dry season farming lucrative and viable thereby increasing rural community empowerment and alleviating poverty. The development objective of Fadama Project is to increase the incomes of fadama users of rural land and water resources on a sustainable basis. It relies on the facilitation for demand driven investments and empowerment of local community groups and to improve productivity and land quality.

National Fadama Development Program (NFDP) is expected to achieve its predetermined objectives especially, with respect to improved vegetable production. Vegetables are among the major dietary intake in our everyday life. They are succulent herbaceous plants that are eaten in part, whole, raw or cooked as part of our main dish or in salad. They are characterized by high moisture content being of the order of 75% moisture or more and 25% or less dry matter. [5] reported that the major crops cultivated in Fadama fields remained the same as leafy vegetables, okra, maize and tomatoes.

The National fadama development program had the general goal of increasing food production in the state through expanded cultivation, using simple small-scale irrigation facilities and appropriate technologies. Small-scale irrigation can be an indispensable technological intervention to increase household income of fadama users; it plays a key role in the basic source of food, income and employment. According to [6] Adequate and efficient irrigation provide a reliable employment, increase cropping intensity, increase yield per hectare and eventually generate more income, hence, high standard of living for the farmer (fadama user).

Small-scale Irrigation has the potential to increase both yields and cropping intensity [7]. It insulates the national agricultural economic sector against weather-related shocks and provides a more stable basis for economic growth and poverty reduction. It supports the process of transforming traditional subsistence agriculture in to market-oriented production of high value crops [8]. The purpose of the study was to examine an assessment on effect of adoption of small scale irrigation technologies by fadama users in agricultural zone III of Niger state, Nigeria. The specific objectives were to:

1. Examine the effects of small scale irrigation technologies on the crop output yield, income, level of living, and labour used on crops;
2. To identify factors influencing the adoption of small-scale irrigation technology by the farmers;
3. To identify constraints of small–scale irrigation technologies in the study area.

1.1 Problem Statement

Agricultural production in Niger State is primarily rain fed, so it depends on erratic and often insufficient rainfall and characterized by low crop and labour productivity, frequent failures or inadequacy of agricultural production. Yet, the state has a potential comparative advantage in the production of a variety of fresh and high-value crops, especially vegetables during the dry season. This is because the study area is endowed in underground and surface water reserves and favourable agro-ecological conditions in the country's low lying planes with alluvial deposits called fadama.

The need for farm production during the off-production/dry season necessitated the current study the research work intends to examine the socio-economic and institutional variables to identify the crops grown by fadama users using small-scale irrigation technologies in the study area, and to examine the fadama farmers that adopted small-scale irrigation technologies in the study area.

[9] stated that Small scale irrigation technologies has the potential to stabilize agricultural production and mitigate the negative impacts of variable or insufficient rainfall. Despite its importance, fadama farmers in Niger State have not fully utilize the technology to boost crop production and recognizing that the full potentials of farmers could not be realized without the use of small scale irrigation technologies an assessment of the problem of fadama farmers in Niger State however, reveals that the farmers is faced by technical problem which submerges farmers persistently in the vicious cycles of low crop productivity.

[10] stated that the incremental production necessary to make food production surpass average population growth rate and guarantee national food security cannot be attained without recourse to supplementary irrigation for the major food production areas of the country.

2. METHODOLOGY

2.1 Study Area

The study was conducted in three Local Government Areas of Niger State. These Local Government Areas are located in Agricultural zone III of the state. The climate and ecological condition of the state is favourable with mean annual rainfall of 782-1250 mm and temperature is about 27.7°C, at latitude 9°36' 50N, longitude 6°33' 25E and Altitude(Meters) 306 [11]. The Agricultural zone has abundant wild vegetation of shea trees and dominated by small scale famers the major crops grown are millet, rice, maize, guinea corn, beans, cassava, tomatoes, okro, vegetables and groundnuts.

2.1.1 Method of data collection and sampling procedure

Multi-stage sampling procedure was used to draw samples for the study. The first stage was purposive selections of Agricultural zone I of the State Agricultural mechanization and development Authority (AMDA) these is because of high concentration of small-scale fadama irrigation farming activities in the zone. This was followed by random selection of three (3) Local Government Areas (LGAs) from the zone which equivalent to three AMDA Extension blocks. These three Local Government Areas are predominately fadama irrigation farming activities in the state. The third stage was random selection of four (4) Extension cells from each of the extension blocks, giving a total sampling size of 180 small-scale fadama irrigation farmers in the study area. Questionnaires and interview schedules were the instruments of data collection. Data collected included: Crop output yield, income, level of living, and labour used on crops.

2.2 Analytical Techniques

Objectives 1 was achieved using descriptive statistics which included measure of central tendency such as mean, percentage, frequency distribution.
Objective 2 was achieved using multiple regression model.

The model is specified as follows:

$$Y=a_o+b1x1+b2x2+b3x3+b4x4+b5x5+u$$

Where:

Y=Adoption of small-scale irrigation technologies (pump machine, basin canal, sprinkler method, centre pivot, micro and drip) (5 technologies)

X1= Age (years)
X2= Level of education (years)
X3= house hold size (number of people)
X4= income (Naira)
X5= Experience (years)

3. RESULTS AND DISCUSSION

3.1 Respondents Yields of Crops with Small-Scale Irrigation and Rain Fed Farming in the Last Two (2) Years

In agriculture crop yield is also known as agricultural output and its refers to both the measure of the yield of a crop per unit area of land cultivated, [12]. The unit by which the yield of a crop is measured is tonnes per hectare. Table 1 shows that 88.3% of the respondents makes between 0.6-1.0 (ton/ha) of maize using rain fed while 88.9% makes an average of between 0.1-0.5 (ton/ha) of maize using irrigation this implies that with rain fed the respondents have higher yield in ton/ha.

Table 1 also reveals that 21.7% get between 0.1-0.5 ton/ha using rain fed to grow okra while a large number of the respondents 78.3% did not respond this is because a large number of the respondents do not use rain fed to grow their okra. The table also reveals that 20.6% of the fadama farmer in the study area have yields between 0.1-0.5 ton/ha of pepper with rain fed.

3.2 Effects of Small-scale Irrigation Technologies on the Annual Average Income of the Respondents

Effect of small scale irrigation technologies on the annual average income of the respondents in the study area include major source of income, respondents access to credit facilities, rough estimate of respondents annual average income, number and value of asset acquired and the specific amount the respondents had collected over the 2 years.

Access to credit is an important factor in agricultural practice, according to [13] which stated formal source of loan to small farmer in any agriculture enterprise increase the level of their involvement. [14] also stated that lack of credit support in agriculture innovation not only reduced the level of income realized from such innovation, but also reduce the level of involvement of the farmer.

Table 2 shows that 73.9% of the respondents had access to credit facilities this implies that the fadama farmer can increase their production or enlarge their farm. 70.6% of the respondents in the study area had their source of credit facility from their cooperatives, this implies that part of the benefit the farmer enjoy from being a member of a cooperative is access to credit from the cooperative and this comes with little or low interest and most time with no collateral.

Table 2 also shows that over the last 2 years 53.9% of the respondents have collected between ₦200,000-₦400,000 from their respective cooperative while 22.2% have collected below ₦200,000 from their cooperatives. [15] stated that support of any kind be it asset, financial or training increase the level of investment of farmers and increase their level of living.

3.3 Respondents Level of Living

The respondent's level of living in the study area is rated or categorise into feeding, housing, clothing, health care, education of children and re-investment. According to [16] who revealed that if there is support from relevant agencies in agriculture innovation the means of consumption expenditure will improve. Table 3 shows that 96.1% of the respondents derive significant improvement in their feeding level this implies that as a result of profit made using small scale irrigation their consumption rate in the area of feeding significantly increase. 42.2% of the respondents have no change in the housing, while 35% had slight improvement in house.

Table 3 also show that 51.1% of respondents had slight improvement in health care service, 47.8% had significant improvement. Also 57.8% had slight improvement in the education of their children and 36.1% had significant improvement, the table also reveals that 36.7 of the respondents in the study area had slight improvement on their re-investment, 33.3% had no change in re-investment and 20.0% had significant improvement in their level of re-investment as a result of adoption of small scale irrigation technology.

Table 1. Respondents yield of crops with small-scale irrigation and rain fed farming in the last two (2) years number of respondents=180

Crops (tons/ha)	With rain fed frequency	with rain fed percentage	with irrigation frequency	without irrigation percentage
Maize				
0.1-0.5	21	11.7	160	88.9
0.6-1.0	159	88.3	20	11.1
Okra				
0.1-0.5	39	21.7	1	0.6
0.6-1.0			38	21.1
No response	141	78.3	141	78.3
Pepper				
0.1-0.5	37	20.6	37	20.6
No response	143	79.4	143	79.4
Other				
No response	160	88.9	160	88.9
0.6-1.0	20	11.1	20	11.1

Source: Field survey, 2014

Table 2. Distribution of respondent's access to credit facilities, source of credit facilities and amount collected over the last 2 years, Number of respondents=180

Variables	Frequency	Percentage
Access to credit facilities		
Had access to credit	47	73.9
no access to credit	133	26.1
Source of credit facilities		
Bank	40	22.2
Co-operation	127	70.6
Personal	1	0.6
Family money	3	1.7
Others	5	2.8
No response	4	2.2
Amount collected within the last 2 years (₦)		
Below 200,000	40	22.2
200,000-400,000	97	53.9
401,000-600,000	39	21.7
No response	4	2.2

Source: Field survey, 2014

3.4 Factors Influencing the Adoption of Small Scale Irrigation Technology

Regression analysis was used in the determine factor influencing adoption of small-scale irrigation technology. The coeffiecnt of multiple determinant (R), which is the contribution of all the dependent variables to the independent was 0.1218 while adjusted R2 value was 0.0966. Table 4 shows that age (3.18), income (-2.03), experience (-2.52) were significant at 1% level of significant. This shows that the age of the respondent is a factor that determine their adoption of small-scale irrigation technologies and majority of the despondent are within the age of 41-50, the years of experience the farmer has in farming is another factor that influence is level of adoption while income also influence their level of adoption.

Table 3. Distribution of respondents level of living number of respondents=180

Variables	Frequency	Percentage
Feeding		
Slightly improve	5	1.1
Significantly improved	173	96.1
Housing		
No change	76	42.2
Slightly improve	63	35.0
Significantly improved	4	2.2
No response	37	20.6
Clothing		
Slightly improve	97	53.9
Significantly improved	81	45.0
No response	2	1.1
Health care		
Slightly improve	92	51.1
Significantly improved	86	47.8
No response	2	1.1
Children's education		
No change	9	5.0
Slightly improve	104	57.8
Significantly improved	65	36.1
No response	2	1.1
Re-investment		
No change	60	33.3
Slightly improve	66	36.7
Significantly improved	36	20.0
No response	18	10.0

Source: Field survey, 2014

Table 4. Result of the multiple regression model for factors influencing the adoption of small scale irrigation technology

Variables	Regression coefficients	Standard error	t. value
Age	0.2266	0.0718	3.16 ***
Education	-0.0249	0.0196	-1.27
Household size	0.0133	0.0300	0.44
Income	-0.0896	0.0326	-2.74***
Experience	-0.0669	0.0193	-3.46***
Constant	0.3947	0.3222	1.22

Source: calculated from data collected, 2014

Number of observation 180

F(5, 174) = 4.83
Prob > F = 0.0004
r^2 = 0.1218
Adjusted r^2 = 0.0966
*** 1% levels of significance

3.5 Constraints Limiting Adoption of Technology or Crop Production with the Use of Small Scale Irrigation Technologies

Some of the constrains highlighted in the study area by the respondents are water shortage, labour, marketing, capital and storage facilities these among others are the respondents constraint. Table 5 show that 94.4% of the respondents said land is not a constraint to them this implies that land is readily available and accessible to the farmers. 61.7% of the respondents face water loose. According to [17] irrigation efficiency is clearly influenced by the amount of water used in relation to the irrigation water applied to the crop and uniformity to the applied water. According to [18,19] water, soil, air and sunshine are four main determinants for crop production. Therefore water is essential to plant growth and crop production.

Table 5 also shows that 85.6% of the respondents have labour as a constraint limiting their increase in crop production. 92.2% of the respondents had problem with marketing their products, 73.9% of the respondents has capital limitation this implies that they do not have the access to capital they required to improve crop production. The table also shows that 99.4% of the respondents show that extension service is not a constraint for increase in crop production which implies that the fadama farmer had enough extension service to make them increase crop production. The table shows that 58.3% of the respondents had problem with storage facilities while 96.1% said improved seed is not a constraint to crop production in the study area.

Table 5. Distribution of respondents based on constraints limiting the increase in crop production number of respondents=180

Variables	Frequency	Percentage
Land		
Land is a constraint	10	5.6
Land is not a constraint	170	94.4
Irrigation water loose		
Water loose is a constraint	170	94.4
Water loose is not a constraint	10	5.6
Labour		
Labour is a constraint	154	85.6
Labour is not a constraint	26	14.4
Market		
Market is a constraint	166	92.2
market is not a constraint	14	7.8
Capital		
Capital is a constraint	133	73.9
Capital is not a constraint	47	26.1
Lack of infrastructure		
Infrastructure is a constraint	146	88.1
Infrastructure is not a constraint	34	18.1
Poor extension service		
Extension service is a constraint	179	99.4
Extension service is not a constraint	1	0.6
Lack of storage facilities		
Storage facilities is a constraint	105	94.4
Storage facilities is not a constraint	75	5.6
Access to improved seed		
Improved seed is a constraint	173	96.1
Improved seed is not a constraint	7	3.9

Source: Field survey, 2014

4. CONCLUSION AND RECOMMENDATIONS

Based on the findings of this research work age, experience and income are factors that influence adoption of small-scale irrigation technologies by the respondents. Majority of the fadama farmer were not formally educated and this can affect the dissemination of improved information. The cost of maintenance and cost of labour is a major factor to consider in the adoptions of irrigation

technology. The study reveals that small scale irrigation technology increases the quality, quantity and market value of crops of the fadama farmer which implies that the adoption of small scale irrigation technology increase the income and improve the respondent level of living (feeding, housing, clothing, health care, child education and re-investment).

The fadama farmer encounters capital constraint because they can only access loan from their cooperation and there is a limit to which they can borrow the other constrains highlighted in the study area by the respondents were water shortage, labour, marketing, poor extension contact and storage facilities are the respondents constraint. It's therefore recommended that small scale irrigation technology with little cost of maintenance and low labour requirement should be introduce to the farmers. Also the result found that majority of the respondents in the study area, do not have access to formal education which aids a major constraints in their adoption of irrigation technologies and this can affect dissemination of information (printed) materials on any new technologies to the respondents, therefore, the respondents should be allowed to have access to formal education.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Anon J. Proposal for Soil Survey and Quality Analysis for Fadama Lands in Bauchi State. 2003;(2):21-46.
2. Asfaw D. Scaling up Agricultural Water Development in Africa, the Case of Ethiopia: Ministry of Water Resources. Federal Republic of Ethiopia. 2007;15-23.
3. Awulachew SB, Merrey D, Van Koopen B, Kamara A. Roles, constraints and Opportunities of small-scale Irrigation and water harvesting in ethiopian agricultural Development: Assessment of Existing Situation. ILRI workshop; Addis Ababa, Ethiopia: International Water Management Institute (IWMI) J. 2010;(3)14-16.
4. Ayanwale AB, Alimi T. The Impact of Agricultural Development Project (ADP) in Kogi. J. Soc. Sci. 2004;9(3):157-161.
5. Banji OA, Okunade EO. Women in Agriculture and Rural Development In: Adedoyin Fola (ED) agricultural extension in Kogi. Published by (ARMIT), Ilorin Kwara state. 2005;70-100.
6. Carl, B.G. The economic role of women in agricultural food processing and rural development in: A summary of a seminar at Greece, Organized by CTA Greece. 2009;1-55.
7. Durant AE. The history of civilization. 2004;47.
8. Field Survey, Questionnaire distribution by enumerators to 180 respondents: Ministry of Agriculture and Rural development, Niger State; 2014.
9. Keller J. & Blrenser RD. Sprinkle and Trickle irrigation. The blackburu press: Caldwell NJ. 2000;625.
10. Kangiwa SU. Perception of Support to Small Scale fares in Northern Nigeria: Paper Presentation at Kaduna State Agricultural Development Authority; 2002.
11. Ndaritsa M. A Comparative study of the methods and performance of micro-finance institutes (MFIS) in poverty alleviation through agricultural financial intermediation to agricultural entrepreneurs in North-central Nigeria PhD thesis Kangiwa; 2002.
12. Purcell, E. (Potential for small-scale irrigation in sub-Saharan Africa: The Kenyan example. In Irrigation technology transfer in support of food security. FAO Water Reports. 2007;14.
13. Ramalan AA, Nwokeocha CU. Effects of furrow irrigation methods, mulching and soil water suction on the growth, yield and water use efficiency of tomato in the Kogi in Savanna. Agricultural water management. 2012;45(3):317–330.
14. Snyder RL, Melo-Abreu JP. Frost protection: Fundamentals, practice and economics (PDF). Food and Agriculture Organization of the United Nations. 2005;1:ISSN: 1684-8241.
15. Tswanye PB. Focus on Women Farmers in Niger State Agricultural Zone 1 Paper Presentation at Women in Agricultural Programme (WIA) Conference at Niger State; 2007.
16. Villano R, Fleming E. Analysis of Technical Efficiency in a Rainfed Lowland Rice Environment in Central Luzon Philippines using a stochastic frontier Paper seriesin Agricultural and Resource Economics University of New England, Armidale. No. 2004 – 2005.
17. Widtose JA. Irrigation Practices publisher: Updesh purhohit for Agrobios, India, Jodhpur. 2001;110-112:ISBN 81 – 7754.

18. World Bank. Kogi State National Fadama Development Program II: Proposal for Project Development Fund (PDF), Block B Grant, Retrieved from; 2001. Available:http://www. gefonline.org

19. Zhou Y, Zhang Y. Abbaspour CK, Yang H, Mosler JH. Economic impacts on farm households due to water reallocation in China‟s Chaobai Watershed. Agricultural water management. 2009;96(1)83-89.

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