4thICAAAE 2013 SEPTEMBER 22-25, Hammamet Tunisia
4th International Conference of the African Association of Agricultural Economists
icaaae.org aaae-africa.org

Towards Commercialization of Irrigated Agriculture in Nigeria: Lessons from the Lower Anambra Irrigation Project South-East Nigeria

AMAECHINA, E.C.; EBOH E.C. & NWAGBO E.C.
DEPARTMENT OF AGRICULTURAL ECONOMICS, UNIVERSITY Of NIGERIA, NSUKKA

Invited paper presented at the 4th International Conference of the African Association of Agricultural Economists, September 22-25, 2013, Hammamet, Tunisia

49- Towards Commercialization of Irrigated Agriculture in Nigeria: Lessons from the Lower Anambra Irrigation Project South-East Nigeria

BEING A PAPER SUBMITTED TO THE 4TH AFRICAN ASSOCIATION OF AGRICULTURAL ECONOMISTS CONFERENCE, HAMMAMET, TUNISIA

BY

AMAECHINA[1], E.C.; EBOH E.C. & NWAGBO E.C.
DEPARTMENT OF AGRICULTURAL ECONOMICS, UNIVERSITY Of NIGERIA, NSUKKA
1 Corresponding author email: ebelchina@yahoo.com, ebele.amaechina@unn.edu.ng

Abstract
Irrigated agriculture commercialization is a necessary step towards realizing Nigeria's goal of poverty reduction and rural development. Commercial irrigation farming in this paper is taken to mean producing above subsistence and utilizing farm resources efficiently. This paper is a case study in the Lower Anambra Irrigation Project South-Eastern Nigeria. A sample of 143 farmers in the scheme, was selected for interview with well structured questionnaire. A focus group discussion with key farmers and River basin development staff was also used to elicit information. Descriptive statistics were used to analyse the socio economic characteristics of the farmers, while a Cobb- Douglas production function analysis was used to ascertain productivity of resources used in the farm. The results show that given the farmer characteristics, and resource efficiencies, opportunity for commercialization of irrigated agriculture in the public sector irrigation scheme exists.

Key Words: Irrigation, sustainability, socio-economics, Efficiency

1.0 INTRODUCTION

Agriculture is the major sector upon which the majority of the rural poor in Nigeria depend. More than 70% of the active labour force is employed in agriculture and the sector contributed 23% of the GDP in 2006 (World Bank 2007). It is the basis for livelihood strategies of many poor people engaged in either production, processing, storing and marketing of agricultural produce (DFID 2002 p10). Agriculture also ensures availability of staple food crops for the poor. The Federal Government identified agriculture as a key development strategy to enable it reach its target of halving poverty and hunger by 2015(Stakeholder Forum on Sustainable Agriculture Development Strategy(SFSADP) 2009). An agriculture focused strategy of poverty reduction requires that agricultural support systems of technology and institutions foster output growth (Todaro and Smith 2003 p 453). The average annual growth rates of the agricultural sector in Nigeria ranges from about 3.3% in the 1990s to an average of 6% in the period between 2004-2009(SFSADP 2009) The growth being witnessed is largely as a result of expansion in cultivated land area rather than increase in productivity.

Agricultural productivity hinges on many factors. The development and use of better yield varieties of crops, together with agro-chemicals like fertilizer and improved irrigation methods are *sine qua non* for productivity increases (Upton 1996,p188-189 ; Handshake 2012 p 8). Irrigation has been defined as "the supplementation of precipitation by storage and or/transportation of water" (Upton 1996: p188). Where irrigation is practiced, it allows the cultivation of high yielding crops and the extension of the farming season beyond the rainy season. This has tremendous implications for the food security and livelihood status of the poor rural dwellers (Upton 1996, DFID 2002, Van koppen, Namara & Safilos Rothschild, 2005).

With a widening gap between demand for food and supply due to urbanisation and rapid population growth in Nigeria, there is need to ensure agricultural productivity. Water is the most critical constraint to food production, because of the distinct dry season lasting from November to March (Musa, 2004 :p2 ; Ogunjimi and Adekalu 2002). Uncertainty in the

adequacy and variability in timing of the start of rainy seasons, or the occurrence of dry spells within them, represent major sources of worry for farmers (Khroda 1996 p). Consequently, in the humid zone agriculture usually requires supplemental water for irrigation when it is not available in the crop growing season. Such supplemental water makes it possible to attain high annual yields with double, or even triple, cropping per irrigated hectare. On the other hand, in the arid and semi arid part of the country, it is too dry to have any intense cropping without irrigation(ICID 1999).
Three main categories of irrigation development exist in Nigeria namely: Public irrigation schemes which are projects controlled by the government, the farmer –owned and operated irrigation schemes and the residual flood plain Fadamas, where the operation is based on traditional irrigation practices, Musa (Undated). The challenge of irrigation practice in Nigeria is how to ensure sustainability. In the past public sector irrigation was operated almost wholly by Government, with farmers playing minimal roles. Increasingly the farmers are taking on more roles even in operation and maintenance in line with global reforms in the sector. Farmers need to operate their farms efficiently to justify the investment in infrastructure and to contribute in funding operation and maintenance of the schemes.

Commercialization of irrigated agriculture is a key and necessary step towards achieving Nigeria's Vision 2020 for Agriculture. Agricultural production in Nigeria has been predominantly subsistence in nature with low input technology. Commercialization is defined to mean a " a virtuous cycle in which farmers intensify their use of productivity enhancing technologies on their farms, achieve a greater output per unit of land and labour expended, produce greater farm surpluses, expand their participation in markets, and ultimately raise their incomes and living standards" (Jayne, Haggblade, Minot and Rashid 2011 p.2). Commercializing irrigation production is also important for Nigeria as issues around sustainability of the financing of public sector Irrigation are being grappled with. Higher incomes for farmers would mean greater capacity to pay for irrigation service delivery.

Past studies on irrigation in Nigeria focused mainly on agronomic aspects, or environmental impact of irrigation (Urama &Hodge 2004, Kebbeh,Haefele&Fagade 2005, Akinbile 2010). Previous studies on commercialization focused on rainfed crop and animal production (Agwu, Anyanwu, and Mendie 2012; Okezie, Suleiman and Nwosu 2012), and on only farm level characteristics for commercialization. Although other factors like institutional linkages widens opportunities for farmers commercialization of production, this has not been examined in context. The questions that arise in the commercialization discuss for irrigated agriculture are: what farmer socio-economic characteristics predispose them to commercialize their production, what institutional linkages are available in the schemes that will foster commercialization, what production efficiencies are the farmers experiencing? These questions underpin this paper with a case study of the Lower Anambra Irrigation Project.

2.0 METHODOLOGY

2.1 Study Area

The area of study is the Lower Anambra-Imo River Basin Project (LAIP) located in Omor Anambra State, Nigeria. The LAIP covers a total area of 5,000 hectares comprising of a net area of 3,850 hectares developed for irrigated cropping and about 1,150 hectares used for rain-fed cropping. The project is located in Aghamelum L.G.A. of Anambra State. The location has two distinct seasons: the rainy season lasting for about 7-8 months of the year (from April/May to October/November) and the dry season lasting for about 4-5 months of the year (from October/November to April/May). The mean annual rainfall is approximately 1,730 mm and is bi-modally distributed with peaks in July and September. The annual maximum and minimum temperatures are about 38^{o}C and 22^{o}C respectively. The Anambra River on the western border of Anambra State, precisely at Ifite-Ogwari is the source of irrigation water for the project (Urama & Hodge, 2004).

The entire landform in the LAIP project area is generally undulating and underlain by the Imo clay shales of the Tertiary Period (Asadu, Okorji & Onah, 1997). The residuum of this shale formation is the parent material of the soils in the whole river basin. The soils in the area are therefore remarkably homogenous. They generally have deep solum depth (≥ 1 meter), medium to fine texture commonly classified as clay loam to silty clay, are of medium to low permeability, have massive granular structure, are slightly sticky and plastic in consistency, and have medium to high water retention capacity, which is about 30 to 40% by volume. This soil type is favourable for irrigated rice cultivation which is the sole crop grown in the scheme. There are six villages in and around the Project area namely: Omor, Umumbo, Umelum, Anaku and Igbakwu. The villagers participate in rice cultivation in this project. Other major crops grown in the area include Okro, cowpea and yam.

2.2 Sampling procedure and Data Analysis

The Lower Anambra Irrigation Project was specifically chosen for this study. The LAIP project is in a transition phase, with its irrigation infrastructure having been in disuse due to deterioration, but currently, it is among the projects selected by the Federal government to re- invigorate and revamp. The farmers currently engage mainly in rain season cropping. The list of project farmers formed the basis of selection. From the list a total of 160 farmers were randomly selected from the project area communities for the interview. After data cleaning, 143 farmers' responses were finally used. Key management staff like the project manager, the head of operations, head of Accounts department were also interviewed to elicit further information on the institutional and management arrangements and the operation and maintenance costs.

Cross sectional data was collected. A focus group discussion with ten representative farmers and four key project staff was first conducted. The FGD ascertained the farmers perception on issues around management and financing of the irrigation schemes and also agricultural production. The input from these discussions formed the basis for the preparation of the questionnaire for this study. Data collected includes socio-economic characteristics of farmers, institutional and management patterns of irrigated agriculture, farmer input costs and output price data. Descriptive statistics such as means, percentages and cross tabulation were used to achieve objective i and ii, while the Cobb Douglass production function

2.3 Model specification Cobb Douglas Production Function

was achieved using Cobb-Douglass Production Function. The Cobb-Douglas production function was used to determine resource productivity and is specified as follows:

$Y = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} ei$

Where Y = Output of major crop in kg

X_1 = Land used in hectares

X_2 = seed used in kg.

X_3 = Labour used in mandays

X_4 = Fertilizer used in Kg

X_5 = other agrochemicals used (₦).

b_1, b_2, b_3, b_4, b_5, are elasticity of response of X_1, X_2 , X_3, X_4, and X_5 to output respectively

a = intercept

ei = error term

To further estimate the resource use efficiencies, the b-values derived from the regression results was used to estimate the ratio of the Marginal Value Product (MVP) of each input to the factor price or Marginal Factor Cost (MFC) of the factor input. Thus

$$\text{Allocative Efficiency} = \frac{MVP}{MFC} = 1$$

Where

MVP = Marginal Value Product of the resource input

MFC = Marginal Factor Cost of the resource input

Where the value of the above ratio is above one, it means that the farmers were under utilizing the production resource. If on the other hand, the above ratio is less than one, it implies that the survey farmers were over utilizing the production resource.

3.0 RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of respondents

Some of the socio economic characteristics of the respondents that can influence commercialization of irrigated agriculture are presented in Table 1 below. The table shows that the majority (116 i.e 81.1%) were below 50 years of age. At this season in life, they are likely to possess the strength and energy required for agricultural production. They are also more likely to take risk to innovate in their farm practice. Ogundele & Okoruwa observed that as farmers' age, there is a tendency that productivity will continue to fall owing to their declining strength. The sex category shows that men farmers were more than female farmers in the scheme. This is different from findings by other researchers in Africa especially for irrigated rice production (Dey 1985, Van Koppen 2002). The household size shows that most of the farmers have large households and this will ensure that they have enough hands for production as rice is a labour intensive crop. The educational attainment of the farmers indicates that majority (88 i.e 61.53%) had post primary education. This is a positive trend as the IFAD Rural Poverty Report 2011 noted that productivity, dynamism and innovation in the rural economy depends on the people being educated. Majority of the respondents (86%) had above five years experience in irrigated rice farming. The longer a person gets to do a job, the more proficient the person would be. Ogundele and Okoruwa (2006) also observed that since farming involves a lot of risks and uncertainties, a farmer who has stayed long in

the business is better able to take appropriate decisions. Access to land is a basic requirement for farming. The farm size holding shows that more than half had less than 3 hectares of land. This is not surprising as part of the goals of public sector irrigation is to reach as many rural **Table 1: Socio Economic attributes of Farmers in the LAIP**

Attribute	Frequency	Percentage
Age		
30 years and below	25	18.1
31-40	46	32.9
41-50	45	31.5
51-60	16	11.2
61 and above	10	7.0
Sex		
Male	136	95.1
Female	7	4.9
Household size		
1-5	92	64.3
6-10	44	30.8
>10	7	4.9
Years of Education		
None	11	7.6
1-6	44	30.8
7-12	66	46.2
>12	22	15.4
Farming Experience		
1-5	20	14.0
6-10	52	36.4
7-12	35	24.5
>12	36	25.2
Irrigated Farm Size		
1ha and below	62	43.4
1.01-3.00	58	40.6
3.01- 5.00	16	11.2
>5.00	7	4.9
Total Annual Income (₦)		
<150,000	24	16.8
150,001-300,000	41	28.7
300,001- 450,000	27	18.9
450,001- 600,000	18	12.6
600,001-750,000	5	3.5
>750,000	28	19.6

Source:Field Survey 2009/2010

dweller as possible leading to allocation of small plots. However to ensure economies of scale, this may need to be reviewed, or the farmers need to operate in collectives. The income distribution of farmers show that majority earned below 450,000 Naira annually. This may be an indicator that their output is poor or that they are not maximizing opportunities for wealth creation well.

As Johnston; Hoanh; Lacombe; Noble; Smakhtin; Suhardiman.;Kam; & Choo. (2010) noted, improving the livelihoods of small-scale farmers who constitute the majority of rural producers is key to building resilience n agriculture.

3 .2 INSTITUTIONAL AND MANAGEMENT ISSUES

Institutional Actors in the LAIP

The Table 2 below shows institutional actors and linkages at the Lower Anambra Irrigation Project. The institutions or organizations that have been or are involved in the irrigation scheme were identified through focus group discussion with key farmers and staff. The table above shows that in the LAIP, half (4) of the organizations identified are government institutions or parastatals: Federal Ministry of water resources, Federal ministry of Agriculture, River Basin Development Authority, and the National Water Resources Institute. It is important to note that the only research agency active in the scheme is the National Water Resources Institute. There was no established presence of extension services in the scheme. This is similar to Ammani, Sani, Kura and Hussaini 2011 findings in the Kano River Irrigation Project in Nigeria. As Kebbeh, Haefele & Fagade (2003) noted, access to information on improved technologies and crop management strategies is critical to improving productivity in the irrigated sector. These services are woefully absent in the scheme. It can also be seen from the table 2 below that farmers in the schemes do not have access to formal financial services as banks or finance institutions are not active in the scheme. According to IFAD (2011) experience has shown that direct access to financial services affects the productivity, asset formation, income and food security of the rural poor. The absence of financial institutions means that those farmers that are hardworking and entrepreneurial have a limit beyond which they cannot enlarge the scope of their farm holdings. The USAID (MARKETS) though has as one of its package for the farmers, a linkage for credit from a MARKET partner bank. Also an NGO – Olam is part of the MARKET partner in the scheme charged with supplying improved variety of rice seed and giving field guideline for the production.

DFID (2001) noted that the main challenge in institutional sustainability is to build good relationships between public authorities, the private sector and civil society. The success of these relationships depends on the relative strengths and interests of the institutions involved. In both schemes, the farmers and key staff interviewed stated that there were no proper linkages and coordination between the institutions, except for the Federal Ministry of Water Resources and the River Basin Development Authority.

Table 2: Institutional Actors in LAIP

	Name of institution	What is achieved Means/how	Impact	Linkage	LAIP
1	Japanese International Cooperation Agency	Construction of the irrigation scheme, training of farmers	Improved livelihood	Government initiated	*
2	Federal Ministry of Water Resources	Provision of O & M fund and support services	Increased income for farmers		*
3	Federal Ministry of Agriculture (ADP)	Provision of support services (input supply)	Increases income for farmers		*
4	River Basin Authority	coordinating water development projects within basins	Livelihood outcomes		*
5	USAID (MARKETS)	Linkages to credit facilities and to market outlets for products	Improved livelihood	Government/USAID initiated	*
6	Research Institutions National Water Resources Institute	Capacity Development	Improved skill and knowledge base		*
7	Banks	Provision of credit	Expansion of production scale		_
8	Input Suppliers (OLAMS and Federal Ministry of Agriculture)	Supply of seeds and fertilizer		USAID initiated	*

Source: Focus group discussions with farmers and Irrigation staff.

The interest of the government is not only to increase crop production, but also to create employment and reduce rural poverty. The Scheme Operators, i.e. the River Basin Authority mediates between the government and the farmers. They have the function of providing water which the farmers want.

3.3 Cobb Douglas determination of Resource Productivity

The influence of inputs used for production on output of rice in the LAIP was determined using cobb douglass production function. The explanatory variables were land, (X1), seed (X2), labour (X3), fertilizer (X4) and agrochemicals (pesticide and herbicide) (X5). The regression result is presented in table 4.17.

Table 3: Estimated Production function for Rice in LAIP

Variables	Regression Coefficients	Standard error	t-value
Intercept	3.729	0.397	9.38
Land	1.081*	0.187	5.77
Seed	-0.233*	0.687	-3.39
Labour	-0.089	0.136	-0.65
Fertilizer	0.302*	0.105	2.86
Chemicals	-0.035	0.041	-0.87

R^2 = 0.88; * = Significant at 1%; Source: field survey 2009/2010

The overall F-value (F= 217.6751; $p \leq 0.05$) of the regression is significant at 5%. The variables that are significant are fertilizer, seed and land. These accounted for 88% of the total variation in yield of rice in the scheme. Fertilizer influences yield positively. That is increasing the application of fertilizer increases the yield of rice. As the coefficient of the Cobb Douglas equation is the elasticity, the following can be inferred: a unit increase in the level of fertilizer will lead to a 30% increase in rice output. This could be because rice responds highly to fertilizer application. As Ogundele and Okoruwa (2006) noted, fertilizer is known to be one of the most critical inputs in rice production. Farm size also influenced yield positively. From the table, since the coefficients are the elasticities, it can be said that a unit increase in land will increase output by 108%. The quantity of seed used was significant but had a negative sign. This could be because the farmers were overusing seeds since it was planted by broadcasting. It could also be because of poor seed management practices.

In a similar study of resource use efficiency in rice production in the Lake Chad area of Borno state, Goni, Mohammed & Baba (2007) found that fertilizer and labour significantly affected the rice output at one percent level. Seed affected the output at five percent level of significance. Farm size was not significant.

3.4 Efficiency of Resource Use in Rice Production

Table 4. Efficiency of Resource Use in Rice Production

Resource	**APP**	**MPP**	**MVP**	**MFC**	**MVP/MFC**
Land	5229.69	5655.21	232881.54	2200	105.8
Seed	50.73	11.84	487.762	196	2.488
Fertilizer	20.25	2.54	251.898	84	2.998

Source: field survey 2009/2010

The table shows the efficiency parameters for rice production in LAIP Omor. It shows that there is allocative inefficiency as resources were under utilized. There is therefore a high potential for farmers to increase their output and income by using more of the resources. These findings agree with that by Goni, Mohammed and Baba (2007), who in measuring efficiency of resource use in rice production in the Lake Chad area of Borno State, found that the ratios of the MVP to the MFC were greater than unity(1) for seed, farm

size and fertilizer. The ratio was less than one for labour. It showed that labour was over-utilized while other resources were under-utilized.

Conclusion and Recommendation

This paper examined the opportunities and challenges of commercializing irrigated agriculture production in the Lower Anambra Irrigation Project. The socio-economic characteristics of the farmers examined showed that the farmers are predisposed for commercialization as majority are young, educated and experienced in farming, with family size that would help supply labour needs. However the farm land allocated to them in the scheme is too small to reap economies of scale. The institutional factors that would favour commercialization are the presence of the USAID MARKETS in the scheme. The programme implementers, however need to ensure that all the package in the program are enjoyed by participating farmers. The farmers efficiency in the use of resources is poor. There is a high potential for farmers to increase their output and income by using more of the production resources.

References

Agwu, NM, Anyanwu, CI &Mendie, EI 2012 'Socio-economic determinants of commercialization among small holder farmers in Abia state, Nigeria' *Greener Journal of Agricultural Science*, Vol 2, no 8 pp 392-397

Akinbile 2010, 'Behavioural pattern of upland rice agronomic parameters to variable water supply in Nigeria', *Journal of Plant Breeding and Crop Science,* Vol 2 no 4 pp 073-080

Ammani , AA Sani, BM Kura HN Hussaini Y 2011, 'An assessment of agricultural extension services in irrigation schemes under RBDA's Control in Nigeria: the case of the Kano River Irrigation Project', *Journal of Agricultural Extension and Rural Development* Vol. 3, no1 pp 13-18

Department for International Development (DFID) 2002 Better livelihoods for poor people

Goni M, Mohammed S & Baba B.A. 2007 'Analysis of Resource-use Efficiency in Rice Production in the Lake Chad Area of Borno State, Nigeria', *Journal of Sustainable Development in Agriculture and Environment.* vol 3 pp 31-37

ICID 1999 Country profile Nigeria. www. Ciid-ciid.org/v_Nigeria.pdf

IFAD (2011) New realities, New Opportunities for Tomorrow's generation. Rural Poverty Report 2011, IFAD, Rome

Jayne, TS, Haggblade, S Minot, N & Rashid S 2011, Agricultural Commercialization, Rural Transformation and Poverty Reduction: what have we learned about how to achieve this? Synthesis report prepared for the Alliance for Commodity Trade in Eastern and Southern

Africa, Kigali Rwanda. Viewed 2nd April 2013 http://fsg.afre.msu.edu/aamp/Kigali%20Conference/Smallholder_commercialization_Synthesis2.pdf

Kebbeh, Haefele &Fagade (2003) Challenges and Opportunity of Improving Irrigated Rice Productivity In Nigeria, West African Rice Development Association. Abidjan, Cote d'Ivoire Viewed 6th June 2008 http://pdf.usaid.gov/pdf_docs/Pnadb849.pdf

Khroda, G. (1996). Strains, Social and Environmental Consequences and Water Management in the Most Stressed Water Systems in Africa. In Rached, E. Eva Rathgeber, E. & D. Brooks (Eds) *Water Management in Africa and the Middle East: Challenges and Opportunities*. IDRC.

Musa, IK. 2004, Significance of Irrigation Sub-sector review towards sustainable agricultural development in Nigeria, position paper from the Federal Ministry of Water Resources Presented at the FWMR/FAO Public Sector Irrigation Review Sept. 2004.

Musa IK Irrigation Management Transfer In Nigeria: A case of financial Sustainability for Operation , Maintenance and Management

Ogundele O.O. & Okoruwa V.O. (2006) 'Technical efficiency differentials in Rice Production Technologies in Nigeria' AERC Research Paper 154 viewed 8th April 2009 www.

Okezie, CA, Sulaiman J & Nwosu AC 2012 ' Farm-level determinants of Agricultural commercialization', *International Journal of Agriculture and Forestry,* vol. 2, no. 2, pp1-5

Todaro MP Smith SC 2003 Economic Development Pearson Education, Delhi

Upton, M 1996 The economics of tropical farming systems, Cambridge University Press, Cambridge.

Urama K.C., & Hodge, I. (2004). Irrigation Externalities and Agricultural sustainability in South Eastern Nigeria. *Journal of Agricultural Economics,* Volume 55 Number 3 pages 479-501 Agricultural Economics Society. Viewed 2007 www.

Van Koppen B, Namara R & Safilios- Rothschild C. 2005. Reducing poverty through investments in Agricultural water management: Poverty and gender issues and synthesis of Sub-Saharan Africa Case Study Reports. Working Paper 101. IWMI Colombo, Sri Lanka

Vegerra, G, Moses, G 2012 'Feeding the Future', Handshake magazine Issue 5 p8-10