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Analysis of the Effects of Agricultural Inputs Price Liberalization on the Production of Sunflower in Khoy Zone

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Abstract

Sunflower is one of four main annual oil plants that cultivated in oil and nut varieties. This plant as an important and industrial food product and because of nutritional features and the potential for earning exchange has become a valuable product in foreign and inner markets and has a special position in agricultural sector. Khoy, by producing 40 percent of sunflower productions of country annually, is the greatest sunflower producer in Iran. The main purpose of this study is the analysis of the effects of inputs price liberalization on production of sunflower producers in this city. This study is according to a field research and cross-sectional data of 2009 have been used for it. Results show input price liberalization policy by increasing inputs prices and decreasing demand amounts of inputs, increases the production costs and decreases the production and totally it`s harmful for sunflower producers. For preventing negative effects of liberalization on production, adopting necessary policies such as merging small farms and making big ones to profit by economies of scale and increasing production and productivity with the resulted incomes from liberalization and spending them in scientific researches to produce with low costs are suggested.

Keywords:
Sunflower, Liberalization, Production factor, Production elasticity, Khoy

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INTRODUCTION

Oil seeds as industrial plants are one of main and strategic products of agricultural sector that are cultivated for providing eatable oil. The importance and value of oil seeds are not only for their oil but also for valuable material that is consumed for nutrition after oil-pressing. Sunflower is one of four main annual oil plants that cultivated in oil and nut varieties. Nut varieties have special oil acids and less oil but oil varieties have 43-49 % oil that is full of D and E vitamins and has an important role in human health. Sunflower oil is important in clearing vessels and preventing brain and heart strokes. Also, it is used to make medicine, soap, colors and cosmetic materials. Because of desirable quality of oil and desirable reaction in unsuitable environment conditions, sunflower has a special position in agricultural sector and can be effective in economies of most countries.

Khoy is the greatest sunflower producer in Iran that produces 40% of sunflower production in country. Moderate weather, susceptible land, suitable market, having high price in comparison with other agricultural products, being precocious and possibility for second cultivation are the most important reasons of sunflower cultivation in this area. Nut varieties of Khoy are rare in color, taste and size and are competitive with other countries products. The products are exported to Persian Gulf countries and if export way becomes paved, thousands of tons of this production can be exported to other countries.

As we know, agriculture is the economic heart of most countries and most likely source of significant economic growth (DFID, 2003). It has been observed as the major and certain path to economic growth and sustainability. In spite of the dominant role of the petroleum sector as the major foreign exchange earner, agriculture remains the mainstay of the economy (NEEDS, 2004) as the economic of most developing countries are built on agriculture. There is strong relationship between agricultural productivity growth and reduction of poverty. Sunflower in agricultural sector of Iran as an important and industrial food product and because of nutritional features and the potential for earning exchange has become a valuable product in foreign and inner markets. Many governments intervene, directly in producing agricultural products through taxations and subsidization, so inputs price are not real. For increasing the ability of economy sector, it`s necessary to use clear and competitive prices of inputs to have economic efficiency. Liberalization policy of agricultural sector as a way of development has been proposed to developing countries by World Bank. Liberalization simply means allowing market forces of demand and supply to determine what to provide, for whom to produce, and the method of production to be used in an economy. Liberalization involves deregulation and the removal or reduction of government`s participation in the economy. Their justifying reasons for this policy are environment protection, decreasing government costs, increasing inputs productivity and stable development of agricultural sector. Since this policy has been enforced in our country since some years ago and now continues, there are some concerns about loss of this sector. The analysis of input price liberalization effects on production is too important because enforcing price liberalization policy by increasing inputs prices and decreasing their consumption affects production and production costs and if these effects are negative, they can make some problems that threat economic and political security of country.

Previous studies on input consumption in agricultural sector and subsidies effects show that subsidy elimination has been one of government`s important economic policies in recent decades. In most countries there were such experiences that we imply some of them.

Gulati (1990) in a study on agricultural input price liberalization claimed according to high and increasing costs of agricultural input subsidies, eliminating these subsidies is necessary but it has some reactions on agricultural sector that needs to more study and analysis. Ready and Deshpande (1992) by analyzing the effects of fertilizer price liberalization in India showed that this policy as an agricultural development tool has both positive and negative effects. Elyasian and Hosseini (1996) in a research on the analysis of effects of agricultural inputs subsidy elimination showed in case of wheat profitability after liberalization is twice as much as before liberalization. In another research Azizi (2005) studied the price liberalization effects of poison and fertilizer inputs on rice in Guilan. Results showed that fertilizer was using in second area –economic area- and price liberalization led to increase in price, decrease in fertilizer consumption and so decrease in production, but poison was using in third area, price increase led to consume in second area. Then by comparing the positive and negative effects of liberalization, continuing the policy was suggested for this input. In another study Karimzadegan, (2006) presented eliminating fertilizer subsidy decreases it`s consumption for wheat and returning to optimal input consumption increases their production and profit. Ayinde *et al.,* (2009) by studying the effects of fertilizer policy on production in Nigeria in two periods (before liberalization and after liberalization) showed despite fertilizer price increase, liberalization leads to production increase. In this study for having more production, controlling inputs prices and educating farmers are suggested. Badmus (2010) by doing the same research on corn production in Nigeria by using of SUR method on time series of 1970-1998 claimed liberalization is ineffective on fertilizer price and consumption but has positive effects on production. Mousavi *et al.*, (2010) studied the welfare effects of eliminating fertilizer subsidy on corn production in Fars. Results showed liberalization despite price increase did not affect fertilizer demand and so it caused high production costs and low profit.

The main objectives of this study are the analysis of input price liberalization effects on sunflower production and it`s production costs. So according to our objectives, we try to derive production function, cost function, production elasticity of inputs and the comparative importance of inputs to show whether the farmers behave logical in applying inputs or not. Then by means of inputs demand functions and inputs demand price elasticity, consumption and production changes are identified.

MATERIALS AND METHODS

In developing countries including Iran, better use of agricultural inputs like land, fertilizer, poison, water and so on, for increasing the production and development of agricultural sector has special importance and there are several tools to achieve them. One of the most important tools for choosing suitable approaches in production and optimal allocation of sources is using production functions. In fact, production functions are one of analysis ways of quantitative relations between the amounts of inputs and production operation. These functions are mathematical relations that identify input conversion rate to output. So we have:

$$y = f(x_1, x_2, \dots, x_n) \qquad (1)$$

Y is the amount of production and $x_i s$ are production inputs.

Agricultural production function is:

$$y=f(x)=Ax_1^{\alpha}x_2^{\beta}\ ,\ \alpha,\beta>0 \qquad (2)$$

Total cost function is:

$$TC= w_1x_1+w_2x_2 \qquad (3)$$

Lagrange function is:

$$\min: w_1x_1+w_2x_2 \quad subject\ to\ \ Ax_1^{\alpha}x_2^{\beta} \geq y \qquad (4)$$

$$l = w_1x_1+w_2x_2+\lambda\left(y-Ax_1^{\alpha}x_2^{\beta}\right) \qquad (5)$$

For minimizing agricultural sector costs, we make derivation toward each production input and put them equal to zero.

$$\frac{\partial l}{\partial x_1} = w_1 - \lambda\alpha\, f(x)/x_1 = 0 \ \Rightarrow\ w_1x_1 = \lambda\alpha f(x) \qquad (6)$$

$$\frac{\partial l}{\partial x_2} = w_2 - \lambda\beta\, f(x)/x_2 = 0 \ \Rightarrow\ w_2x_2 = \lambda\beta f(x) \qquad (7)$$

$$w_1x_1+w_2x_2=\lambda(\alpha+\beta)f(x) \qquad (8)$$

Then we give joint powers to the both sides of first condition equations, find the amount of $\boldsymbol{\lambda}$ and put in cost equation as follows:

$$w_1^{\alpha}x_1^{\alpha} = \lambda^{\alpha}\alpha^{\alpha}f(x)^{\alpha}\ \ ,\ \ w_2^{\beta}x_2^{\beta} = \lambda^{\beta}\beta^{\beta}f(x)^{\beta} \qquad (9)$$

$$\Rightarrow\ \left(w_1^{\alpha}w_2^{\beta}\right)f(x) = A\lambda^{\alpha+\beta}\left(\alpha^{\alpha}\beta^{\beta}\right)f(x)^{\alpha+\beta} \qquad (10)$$

$$= \left(\frac{w_1^{\alpha}w_2^{\beta}f(x)}{A\alpha^{\alpha}\beta^{\beta}f(x)^{\alpha+\beta}}\right)^{\frac{1}{\alpha+\beta}} \qquad (11)$$

$$c(y,w_1,w_2) = w_1x_1 + w_2x_2 = \lambda(\alpha+\beta)f(x) \quad (12)$$

$$\lambda(\alpha+\beta)f(x) = (\alpha+\beta)BA^{\frac{-1}{\alpha+\beta}}y^{\frac{1}{\alpha+\beta}}\left(w_1^{\frac{\alpha}{\alpha+\beta}}w_2^{\frac{\beta}{\alpha+\beta}}\right)$$

$$,\ B=\left(\alpha^{\frac{-\alpha}{\alpha+\beta}}\beta^{\frac{-\beta}{\alpha+\beta}}\right) \quad (13)$$

$$\ln C = \ln(\alpha+\beta) + \ln B - (1/(\alpha+\beta)\ \ln A + (1/(\alpha+\beta)\ \ln y + (\alpha/(\alpha+\beta)\ \ln w_1 + (\beta/(\alpha+\beta)\ \ln w_2 \quad (14)$$

Coefficients of each parameter in above equation are cost elasticities of inputs. Also we have this result as scale elasticity:

$$\frac{AC}{MC} = \frac{Costs}{y(\partial C/\partial y)} = \left(\frac{\partial \ln C}{\partial \ln y}\right)^{-1} = (\alpha+\beta) \quad (15)$$

Then we find demand functions of each input:

$$x_1(y,w_1,w_2) = \frac{\partial C}{\partial w_1} = \alpha BA^{\frac{-1}{\alpha+\beta}}\, y^{\frac{1}{\alpha+\beta}}\, w_1^{\frac{\alpha}{\alpha+\beta}-1}\, w_2^{\frac{\beta}{\alpha+\beta}} \quad (16)$$

$$x_2(y,w_1,w_2) = \frac{\partial C}{\partial w_2} = \beta BA^{\frac{-1}{\alpha+\beta}}\, y^{\frac{1}{\alpha+\beta}}\, w_1^{\frac{\alpha}{\alpha+\beta}}\, w_2^{\frac{\beta}{\alpha+\beta}-1} \quad (17)$$

This study is according to a field research and cross-section data of 2009 have been used for it. We spent 2 months for collecting data. At first we took the names of all sunflower producers of Khoy that were 5000 units then we classified the statistical universe of producers to 3 classes according to the size of cultivated land, (0-4] hectares, (4-8] hectares and (8, more) hectares, that 60% of lands were between (0.25-4) hectares, 30% of lands were between (4-8) hectares and less than 9% were more than 8 hectares. After classification, by using of classified random sampling, we could get optimal sample volume by:

$$n = \frac{Z^2_{\frac{\alpha}{2}}.\sigma^2}{d^2} \quad (18)$$

So for every class by random method we chose a volume of $n_h=n.N_n/N$ that n is optimal amount of sample for statistical universe. Since our method was random, for identifying optimal n, we should know the sum of all classes is equal to the optimal amount of sample of statistical universe. We know for collecting samples of n>30, mean sampling distribution is normal. So:

$$\sum_{i=1}^{h} n_h = n \qquad d = Z_{\frac{\alpha}{2}}.\frac{\sigma_x}{\sqrt{n}} \quad (19)$$

$$\sqrt{n} = \frac{Z_{\frac{\alpha}{2}}.\sigma}{d} => n = \left(\frac{Z_{\frac{\alpha}{2}}.\sigma}{d}\right)^2 = \frac{Z^2_{\frac{\alpha}{2}}.\sigma^2}{d^2} \quad (20)$$

In above equations, d is the maximum amount of authorized error, σ_x^2, the variance of statistical universe and z, standard normal distribution by α significance level. For calculating variance, we used, *σ =(Xmax-Xmin)/ε*. The variance of statistic universe was 400, so σ_x=20. Then we calculated the optimal amount of each class.

$$n = \frac{(1.96)^2.400}{(4.65)^2} \approx 70 \quad (21)$$

After having total optimal number and optimal number of sample for each class, by using of random numbers table, we took the names of sample sunflower producers and finally found essential data for study.

RESULTS AND DISCUSSIONS

Empirical studies and sampling methods in producing sunflower seeds show factors like seed, labor, fertilizer and watering times are the main factors of production function in this sector. Applied production function in this study is Cobb-Douglas. Cobb-Douglas function has better goodness of fit toward other agricultural production functions. So this function was used for estimating the relation between sunflower production and inputs. Sunflower production function that has been estimated by ordinary least squares method is presented as:

$$\ln y = -4.092 + 0.785\ \ln s + 0.365\ \ln l + 0.751\ \ln w + 0.139\ \ln f \quad (22)$$

t- statistics: (-4.25) (2.9) (1.58) (2.67) (1.85)

The numbers inside parentheses are t- ratios that show all variables of production function have significance in 95% confidence level. R^2=75% and $\bar{R}^2$=69% that according to cross-section data are acceptable amounts. Also F-statistic related to analysis of variance is 12.256

Table 1: The results of estimation by Microfit 4.1

Regressor	coefficient	t-statistic
Constant	-4.092	-4.25
Lns	0.785	2.9
Lnl	0.365	1.58
Lnw	0.751	2.67
Lnf	0.139	1.85
R-squared		0.75
R-Bar-squared		0.69
F-statistic		12.256
DW-statistic		1.8

that presents the significance of total regression in 95% confidence level. Also according to the results of White test, there is no problem of heteroscedasticity and not having correlation are admitted by (D.W) statistics. Following table presents the results of estimation by Microfit 4.1.

As we know estimated coefficients of equation are inputs production elasticities. According to coefficients, sensitivity of production toward watering times and seed in comparison with others are more and production has the least sensitivity toward fertilizer. All production elasticities are between zero and one that show inputs are used in second area-economic area-that is true about Cobb-Douglas functions. Production elasticity shows the sensitivity of production toward inputs demand. Here seed and water have more sensitivity toward their demand change and fertilizer has the least sensitivity.

In Cobb-Douglas production function, the sum of all production elasticities is the amount of scale elasticity. We have:

$$E=E_s+E_l+E_w+E_f \quad (23)$$

So scale elasticity is 2.04 that is more than one and shows increasing returns to scale. Increasing returns to scale happens in decreasing part of long term average cost curve with economies of scale. On the other hand, in this amount, firm can decrease it`s average cost by increasing it`s production.

For studying price elasticities and cost elasticities, we need cost function. According to duality rule, we derive cost function as follows:

$$\ln C = 1.91 + 0.49 \ln y + 0.385 \ln w_1 + 0.179 \ln w_2 + 0.368 \ln w_3 + 0.068 \ln w_4 \quad (24)$$

$w_i s$ are the price of each inputs. Now we can get demand equations.

$$x_1 (y, w_1, w_2, w_3, w_4)=1.31.\ 0.017^{-0.49}\ y^{0.49}\ w_1^{-0.615}\ w_2^{0.179}\ w_3^{0.368}\ w_4^{0.068} \quad (25)$$

$$x_2 (y, w_1, w_2, w_3, w_4)=0.61.\ 0.017_{-0.49}\ y_{0.49}\ w_1^{0.385}\ w_2^{-0.821}\ w_3^{0.368}\ w_4^{0.068} \quad (26)$$

$$x_3 (y,w_1,w_2,w_3,w_4)=1.25.0.017^{-0.49}\ y^{0.49}\ w_1^{0.385}\ w_2^{0.179}\ w_3^{-0.632}\ w_4^{0.068} \quad (27)$$

$$x_4 (y,w_1,w_2,w_3,w_4)=2.230.017^{-0.49}\ y^{0.49}\ w_1^{0.385}\ w_2^{0.179}\ w_3^{0.368}\ w_4^{-0.932} \quad (28)$$

If we write logarithmic form of demand equations, gained coefficients of inputs prices show inputs price elasticities. Following table presents price elasticity amounts of sunflower inputs.

Above table shows price elasticities are completely according to demand rule. All inputs price elasticities are negative. Seed has the least and fertilizer has the most amount of elasticity. 1% increase in seed price lead to 0.615% decrease in seed demand also if fertilizer price increases 1%, it`s demand will decrease 0.932%. Elasticity of fertilizer demand is about one and price changes have more effect on it`s demand. Seed demand because of low severity toward price changes takes less effect. Also this matter is true about other inputs.

Now, if price liberalization policy is enforced, the price of seed and fertilizer will increase. According to demand price elasticity of inputs, farmers demand for these inputs will decrease.

Table 2: price elasticity and intersecting elasticity of sunflower inputs

Inputs	Seed	Labor	Water	Fertilizer
Seed	-0.615	0.179	0.368	0.068
Labor	0.385	-0.821	0.368	0.068
Water	0.385	0.179	-0.632	0.068
Fertilizer	0.385	0.179	0.368	-0.932

On the other hand, with these amounts of production elasticities for inputs, by decreasing their demand, the amount of production will decrease. Of course by using of input substitution, we can take the production level at the same amount. So input price liberalization policy by increasing the price of inputs, increases the costs of production and decreases the production and totally it`s harmful for sunflower producers.

CONCLUSION AND RECOMMENDATION

Study results show that input price liberalization policy has negative effect on sunflower production. According to gained results, all inputs are used in second area of production –economic area- so liberalization policy by increasing inputs prices, according to demand rule, decrease the demand amounts of inputs and decrease in inputs consumption cause production decrease.

Gained price elasticity is about one for fertilizer that shows 1% increase in fertilizer price causes 1% decrease in input demand amount. Decrease in it`s consumption lead to production decrease that is harmful for sunflower producers. According to demand inelasticity of seed, sunflower producers reaction toward price increase won`t be too severe but it will have demand decrease of this input and finally according to seed production elasticity, the amount of production will decrease. In conclusion, the effect of inputs price liberalization policy on sunflower industry, is increase in production costs and decrease in sunflower production. So for enforcing policy, we need adopting exact and planned policies. According to gained results, following suggestions are presented:

Agricultural organizations should have true supervision on the amount, time and the way of input consumption and help farmers to increase their scientific informing to use inputs optimally and therefore increase their production and efficiency.

Government can compensate extra costs of farmers resulting from liberalization policy by giving cash subsidies. These subsidies could be paid based on the amount of production or cultivated land. In this way farmers distribute the cash subsidy among all inputs and decrease severe use of one input.

For preventing negative effects of liberalization on production by merging small farms and making big ones, we can benefit of economies of scale and increase our profit. It`s clear that increase in profit leads to increase in production and efficiency.

Also government should pay more attention to scientific and especially genetic researches and increase the research budget of R&D centers and universities to produce with low costs and improve total factor productivity.

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The Impact of Bio-Ethanol Conversion and Global Climate Change on Corn Economic Performanve of Indonesia

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Abstract

Many studies conclude that the rise in global food prices due to higher demand from the development of bio-fuels, climate anomalies, and increased of oil prices. Not only the food commodity index rose more than 60 percent, non-food commodity price index also rose over 60 percent and crude oil price index has increased even further above 60 percent. The purpose of this study is to analyze the impact of bio-ethanol conversion and global climate change on corn economic performance of Indonesia. The results showed that the food crisis caused by climate anomalies lead the world corn prices rose 50 percent, impact on Indonesia corn imports fell by 11.86 percent. And the other hand, the energy crisis that caused the corn used as feedstock for ethanol that caused U.S. corn exports only 20 percent of their products have an impact on Indonesia on maize imports fell 32.4 percent.

Keywords:
The energy crisis, Climate change, Corn

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INTRODUCTION

Corn is the third largest crop after wheat and rice, most of the corn products are used and traded as feed material in addition to a staple food. In addition to food and feed, corn has a wide range of industrial applications such as materials for the manufacture of ethanol.

Over the last decade of global corn production has shown increasing growth, the global corn market generally divided into two issues, first, the conversion of the global corn used as bio-ethanol industry, second, the share of globally traded corn are relatively constant.

The main cereal market - corn, wheat and rice - has shown some major adjustments in recent years. Since 2008 the global food crisis resulted in a large spike in corn prices. On the demand side of high oil prices encourage the development of bio-fuel which resulted in increased demand in addition to dietary changes and income and population growth. High oil prices also put pressure upward on the cost of crop production (e.g. fertilizer, tillage). On the supply side with low cereal stocks, exacerbated by a policy of trade restrictions on cereal and speculation in commodity markets. (Flammini, 2008).

The food crisis followed by the global financial crisis in the second half of 2008, high oil prices which led to concerns about the security of national oil and concerns about the environmental impact of fossil fuel use resulting in searching alternative energy sources, one of the interesting issues is the development of bio-fuels that affect the global corn market.

In the United States, the enhanced production of bio-ethanol because corn prices are relatively low, In the year 2007-2008, as many as 82 million tones of corn used for ethanol, which represents a quarter of U.S. corn production and 12% of global production (DEFRA, 2008). Besides the development of bio-ethanol, one of the factors that cause serious problems for the production of corn from time to time is the occurrence of El Niño weather phenomenon associated with an abnormal warming of sea surface temperatures in the Pacific Ocean. Corn plants are most affected by El Niño (mostly in the form of prolonged dry conditions) are concentrated in the southern hemisphere, particularly in southern Africa. During El Niño events of the 1980s and the 1990s, for example, corn production in the Republic of South Africa fell by 40 to 60 percent. Also in Brazil, corn producers suffered from floods and droughts driven by El Niño situation in the past. adverse weather conditions caused by the events of the last major El Niño of 1997/98 are located mostly in East Asia and led to a sharp decline in production in countries such as Thailand and Indonesia.

In Indonesia, corn has a very strategic role, especially for the farm development and other industries. In past, corn mainly used as staple. However, currently, corn mainly used as an industrial material. In line with the rapid growth of livestock industry, it is estimated more than 55% of domestic corn needs is used for feed, while for food consumption is only about 30%, and the remainder for other industrial needs and seeds (Indonesia Department of Agriculture, 2010).

Currently, the development of corn production can not meet high demand. Therefore, the governments meet the shortage of these needs through imports. For 2010 forecast figures, with area of 3 million ha of crops, it is estimated to produce 12.1 million tons.. Meanwhile, maize demand in the country reached 13.8 million tons, resulting in a shortage about 1 million ton to be imported (Ferrianta, 2012). If the import increment increase was not controlled, it will cause a reduction in foreign exchange, and can lower the domestic maize price, where the price was relatively low. Based on these facts, the government is trying to meet the domestic maize need through maize self-sufficiency program.

Maize self-sufficiency effort must be directed to external factors, not only change in domestic policy but also external shock e.g bio-ethanol development and global climate change. In line with the development of world economy, maize commodity will face a different environment. External and internal shock will affect corn economic performance of Indonesia.

Based on these facts, it is deemed necessary to conduct research on the impact of bio-ethanol development and global climate change on the economic performance of corn in Indonesia.

MATERIALS AND METHODS

Indonesia maize economic model is a simultaneous equations consisting of three sub-models: sub production, sub domestic market and sub world markets. The data collected is secondary time series data.

Model estimation is done using re-specification model. The goal is to obtain good models based on economic and econometrics criteria. In the estimation of these models studied the problem of identification, aggregation and the degree of correlation between explanatory variables.

Evaluation conducted to know the impact of instrument change simulation variable on the future endogenous variable. The evaluation model is based on economic theory and information related to the research phenomenon. A model is good if it meets the following criteria:

1. Economics, in association with signs and estimation parameters,
2. Statistics, relating to statistical tests, and
3. Econometrics, related to the model assumptions (Baltagi, 2008)

For unbiased and consistent estimations, simultaneous systems require a more complex procedure for estimation than single equation models, which can generally be estimated by regression with ordinary least squares (OLS). The most frequently used method of estimating simultaneous systems is the two-stage least squares (2SLS) method (Studenmund, 1997; Greene, 1993).

Furthermore, because the model contains a simultaneous equations and lagged endogenous variables, serial correlation test is performed using statistical dw (Durbin-Waston Statistics) in each equation. (Gujarati, 2004)

Model validation performed to analyze how constructed model could to represent the real world. In this study, statistical validation criteria for value estimate econometric model is Root Means Squares Error (RMSE), Root Means Squares Percent Error (RMSPE) and Theil's Inequality Coefficient.

Econometric modeling and estimation can be useful in providing a retrospective look at the economic effects of a policy change or external shock (MCDaniel, 2006). To simulation the impact of external shock to the import corn Indonesia, this study was used ex-post econometrics analysis to see changes in the value of endogenous variable due to changes in exogenous variables. (T. B. Palaskas 1988 ; Baumann, 2011).

Dynamic simultaneous equations system used to develop econometric model. Models specification used are described as follows:

1. $QJ = AJ * PRJ$
2. $AJ = a_1 PJ + a_2 Pkdl_{t-1} + a_3 AJ_{t-1} + U_1$
3. $PRJ = b_1 Pp + b_2 i + b_3 AJ + b_4 W + b_5 PRJ_{t-1} + b_6 CH + U_2$
4. $DIT = DIP + DIL + DK$
5. $DIP = c_1 Ppk + c_2 Pj + c_3 Pkdl + c_4 DIP_{t-1} + U_3$
6. $DIM = d_0 + d_1 Pop + d_2 PJ + d_3 Pni + U_4$
7. $DK = e_0 + e_1 PJ + e_2 Y + e_3 DK_{t-1} + U_5$
8. $MIT = MIAS + MICH + MITH + MIO$
9. $MIAS = f_1(PIAS - PIAS_{t-1}) + f_2 QJ + f_3 DIT + f_4 ERI + f_5(RISTI - RISTI_{t-1}) + U_6$
10. $MICH = g_1 PICH + g_2 QJ + g_3 DIT + g_4 RISTI + U_7$
11. $MITH = h_1 PITH + h_2 QJ + h_3 DIT + h_4 RISTI + U_8$
12. $MIO = MIT - (MIAS + MICH + MITH)$
13. $RISTI = (PJ – PWJ)/ PWJ$
14. $PIAS = PWJ + RISTAS$
15. $PICH = PWJ + RISTCH$
16. $PITH = PWJ + RISTTH$
17. $PJ = i_1 MIT + i_2 DIT + U_9$
18. $XAS = j_0 + j_1 QAS + j_2 DAS + j_3 XTH + j_4 XCH + j_5 MJJ + j_6 MJK + j_7 PETH + U_{10}$
19. $XCH = k_1 QCH + k_2 DCH + j_3 XAS + j_4 XTH + j_5 MJJ + j_6 MJK + U_{11}$
20. $XTH = l_0 + l1_P WJ + l_2 QTH + l_3 DTH + U_{12}$
21. $MJJ = m_0 + m_1 PWJ + m_2 NPRJj + m_3 ERj + U_{13}$
22. $MJK = n_0 + n_1 PWJ + n_2 DJk + n_3 MJK_{t-1} + U_{14}$
23. $XW = XAS + XTH + XCH + XRO$
24. $MW = MJJ + MJK + MRO$
25. $PW = o_1 XW + o_2 MW + U_{15}$

Note:

- AJ = acreage of corn harvested (ha)
- PRJ = productivity corn of Indonesia (tones / ha)
- QJ = corn production of Indonesia (tones)
- PJ = corn prices of Indonesia(US $ / tone)
- i = Indonesia interest rate (%)
- W = Indonesia wage labor (US $ / day)
- Pp = the price of fertilizer (US $/ tone)
- CH = climate change (oceanic nino index)

• DIT = total corn demand of Indonesia (tones)
• DIP = Indonesia corn demand for feed industry (tones)
• DIM = Indonesia corn demand for food industry (tones)
• DK = Indonesia corn demand for direct consumption (tones)
• KDP = feed prices of Indonesia (US $ / tone)
• Pkdl = soybean price of Indonesia (US $ / tone)
• Pop = population of Indonesia (people)
• MIT = Total Imports corn of Indonesia (tones)
• MIAS = Indonesia corn imports from US. (tones)
• MICH = Indonesia corn Import from China (tones)
• MITH = Indonesia corn imports from Thailand (tones)
• MIO = Indonesia corn imports from other countries (the rest)
• PIAS = the price of corn imports from US (US $ / ton)
• PITCH = the price of corn imports from China (US $ / ton)
• PITH = the price of corn imports from Thailand, (US $ / ton)
• RISTI = corn trade restrictions of Indonesia
• ERI = exchange rate of Indonesia (rupiah / US $)
• XAS = US corn exports (thousand tones)
• XTH= Thailand corn exports (thousand tones)
• XCH= Chinese corn exports (thousand tones)
• QAS = U.S. corn production (thousand tones)
• QTH = Thailand corn production (thousand tones)
• QCH= Chinese corn production (thousand tones)
• MJJ = Japan corn imports (thousand tones)
• PET = ethanol price (US$/bushel)
• MJK = Korea corn imports (thousand tones)
• DJ = corn demand of Korea (thousand tones)
• NPRJ= corn trade restrictions of Japanese (thousand tones)
• ER = exchange rate of Japan (Yuan / US $)
• XW = world exports (thousand tones)
• XRO = corn exports of other country (thousand tones)
• MJW = world corn imports (thousand tones)
• MRO =corn exports of other country (thousand tones)

This study used *time series data's*, starting in 1983 until 2010. The data is obtained from Indonesia Department of Agriculture, Bureau of Indonesia Statistics, Indonesia Ministry of Agriculture, Directorate General of Food Crops and Horticulture, Food and Agriculture Organization, United States Department of Agriculture, United Nations Commodity Trade Statistics Database, and International Monetary Fund.

RESULTS

International corn economy has undergone major changes over the past two decades in terms of production, utilization, trade and marketing structure. This change was driven by a number of factors ranging from rapid advances in seed technology and production, changes in national policy and international trade, expansion almost without interruption from the use of feed throughout the world and recently huge demand for ethanol.

Production

Over the past two decades, global corn production has increased nearly 50 percent, or 1.8 percent growth rate per year. Most of the increase in world corn production over the past decade can be attributed to rapid expansion in Asia.

Asian corn production grew nearly 35 percent over the past decade, nearly 30 percent of the global increase. The increasing expansion of acreage and yield contributed to high growth rates, like China that makes the most significant progress with contributions as much as 60 percent of total corn production of Asia over the past decade.

Although progress is associated with varieties that have high productivity, it is likely to increase corn production in many countries remains large along with the good level of production efficiency, especially in developing countries are still under

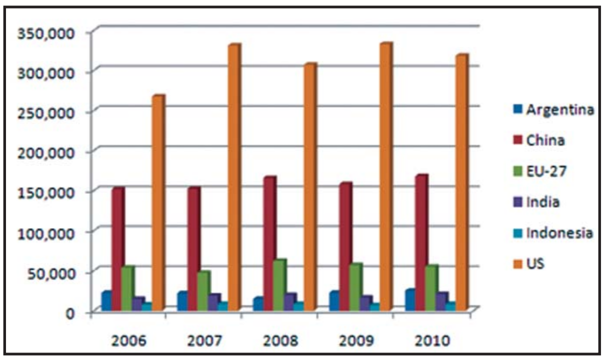

Figure 1: World Corn Production (Sources: USDA, 2010)

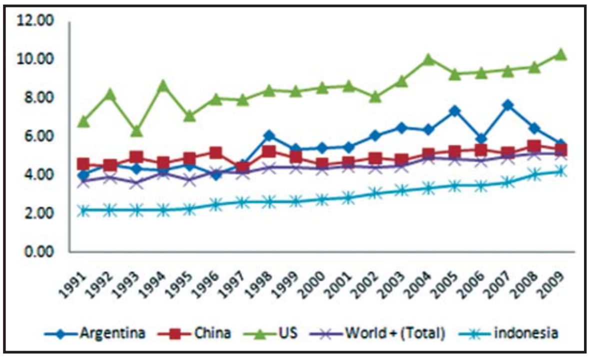

Figure 2: Corn Productivity in Some Countries (Sources: FAOSTAT, 2010)

major manufacturers. Average corn yields among developing countries about a third of the countries major corn producer. Among some of the countries largest producer of corn (Figure 2), Argentina approximately 5.6 tones / ha, China about 5 tones / ha, while Indonesia about 3 tones / ha. This is much compared to the United States about 10 tones / ha.

Corn as Biofuels Material

Bio-diesel is an alternative diesel fuel energy sources are derived from vegetable oil (vegetable oil) and animal fats (animal fat) where corn is one potential source of bio-diesel product. World price of bio-diesel (FOB Central Europe) increased to $ 4.14 per gallon by 2010, driven by high oil prices and prices of edible oils. Increased crude oil prices and the existence of tariff barriers in Argentina, Brazil, European Union, as well as the U.S. led to an increase in world prices.

With the huge consumption demand for local industrial production of bio-diesel will increase production by 5% in 2010 and estimated production continues to increase and reached 3.5 billion gallons by 2019, on the other hand the consumption continues to grow to 4.0 billion gallons by 2019 so that the net import grow during the outlook period and reached 559 million gallons by 2019.

General Estimation of Econometrics Model

The empirical result of prediction models in the study is good. All exogenous variables included in the structural model has a parameter that the sign suitable with the theory and logical. Statistical criteria used in evaluating the prediction is quite good. Coefficient of determination (R2) value in each behavioral equations ranged from 0,38 to 0.99. From 15 behavioral equations, there is only one behavioral equation with R2 values of 31 percent and 14 other equation is above 64 percent. This shows that, in general, the exogenous variables included in the structural equation model can explain variance rightly for each endogenous variable.

The value of statistic F test generally high. There are 12 of 15 equation had value greater than 11.22. Meanwhile, only two equations have F-value 8,50 and a 1,38. That is, simultaneously, explanatory variable variance in each equation behavior are able to explain the variance of endogenous variable, at α= 0.0001; α = 0.0003 and α=0.2744. Detailed econometric model estimation for maize are presented in Table 1.

Simulation of External Shocks on the Economic Performance of Indonesia corn Performance

The world has been experiencing a global crisis caused by global warming, energy crises, and monetary crisis. Global warming has caused climate anomaly, resulting in a sharp decline in world agricultural production resulting food crises, including maize.

Global food price index increase has reached 120 percent, where about 60 percent in just the past two years, while the World Bank stated that the price index of food crops increased 86 percent between 2006 to 2008. Agricultural commodity prices rose in 2006 and 2007 and continued to increase even more sharply in 2008. Meanwhile, according to the World Bank, global wheat prices increased by 81 percent (World Bank, 2008), and 83 percent increase in overall global food prices.

The energy crisis has led to the development of corn as a bio-fuel feedstock, resulting in a decrease in world corn exports, especially in the US. The figure below shows the extent of the use of corn for the bio-fuels industry the United States, 1984-2009 a huge surge in the use of corn as an ethanol feedstock domestic product, this indication will be a large drop in exports US, in addition to other major exporting

Table 1: Econometrics Model Estimation

Model	Variable	coefficient	t-statistic	statistic
AJ	PJ	5.3656	0.41	0.6882
	PKDLL	-0.37924	-0.75	0.4618
	AJL	0.962391	7.61	<.0001
	F-test= 1016.30	R^2= 0.99284	DW = 1.73635	
PRJ	PUPUK	-5.87E-10	-2.57	0.0186
	I	-0.04547	-3.01	0.0072
	AJ	5.259E-08	0.31	0.7584
	W	-0.00018	-0.41	0.6869
	PRJL	1.246336	14.97	<.0001
	CH	-0.02339	-1.21	0.2416
	F-test = 2640.65	R^2= 0.9988	DW = 1.286932	
DIP	PPK	41.06936	2.19	0.0397
	PJ	-34.4608	-1.15	0.2642
	DIPL	0.881228	4.48	0.0002
	PKDL	-0.33793	-0.17	0.8647
	F-test= 92.47	R^2= 0.94628	DW = 1.241174	
DIM	Intercept	-15280000	-3.86	0.0009
	PJ	-128.926	-1.13	0.2709
	PNI	56.18753	5.59	<.0001
	POP	0.023537	3.18	0.0045
	F-test=12.62	R^2= 0.64325	DW = 0.880593	
DK	Intercept	769281.5	1.18	0.2496
	PJ	-22.447	-0.94	0.3578
	Y	-62.2421	-0.45	0.654
	DKL	0.652367	7.14	<.0001
	F-test= 58.46	R^2= 0.89306	DW = 0.985704	
DIT	DIT = DIP + DIM + DK			
MIAS	PIASH	-50301.5	-0.32	0.7514
	QJ	-0.39767	-5.13	<.0001
	DIT	0.403125	5.33	<.0001
	ERI	-16.0265	-0.84	0.4118
	RISTIH	-75.6419	-0.21	0.8352
	F-test= 13.82	R^2= 0.77557	DW = 2.307239	
MICH	PICH	-540.767	-0.35	0.728
	QJ	-0.15933	-1.27	0.2183
	DIT	0.195036	1.9	0.0716
	RISTI	-624179	-1.83	0.0815
	F-test= 8.28	R^2= 0.61206	DW = 1.874842	
MITH	PITH	-819.626	-1.62	0.1206
	QJ	-0.02801	-0.73	0.4737
	DIT	0.046871	1.41	0.1737
	RISTI	-45811	-0.37	0.7169
	F-test= 8.76	R^2= 0.62518	DW = 1.429704	
MIT	MIAS + MICH+ MITH+MIO			
PJ	MIT	-0.00093	-0.3	0.7638
	DIT	0.001993	6.89	<.0001
	F-test= 86.26	R^2= 0.88237	DW = 0.136375	
XAS	Intercept	9262248	0.11	0.9148
	QAS	0.061165	0.53	0.5999
	DAS	-0.02246	-0.14	0.8919
	XTH	-0.03033	-0.01	0.991
	XCH	-0.53669	-1.57	0.1352
	MJJ	3.226394	0.61	0.5487
	MJK	0.971053	0.91	0.3738
	PETH	-23310000	-1.38	0.1848
	F-test= 1.52	R^2= 0.38465	DW = 1.937323	
XCH	QCH	0.174571	1.2	0.2436
	DCH	-0.23146	-1.26	0.2232
	XAS	-0.23542	-1.76	0.0948
	XTH	-0.74319	-0.66	0.517
	MJJ	1.194996	2.27	0.0348
	MJK	0.638035	1.02	0.3217
	F-test=11.23	R^2=0.78010	DW = 2.12621	
XTH	Intercept	-427222	-1.98	0.0614
	PWJ	2148.176	2.73	0.0124
	QTH	1.011109	20.58	<.0001
	DTH	-0.93046	-40.62	<.0001
	F-test= 612.58	R^2= 0.98870	DW = 2.079181	
XW	XAS +XTH +XCH + XO			
MJJ	Intercept	21603517	10.37	<.0001
	PWJ	-8992.84	-1.44	0.165
	NPRJ	-148722	-1.49	0.1504
	ERJ	-24401.7	-4.73	0.0001
	F-test=14.61	R^2=0.67603	DW = 2.337765	
MJK	Intercept	-122641	-7.82	<.0001
	PWJ	-234.022	-1.85	0.0789
	DJK	1.005725	536.15	<.0001
	MJKL	0.003463	2.03	0.0549
	F-test= 130684	R^2= 0.99995	DW = 1.885428	
MW	MJK + MJJ + MIT +MJO			
PW	XW	-1.41E-07	-0.18	0.8566
	MW	1.72E-06	2.2	0.0382
	F-test= 227.42	R^2= 0.95187	DW =1.126065	

Source: Research findings.

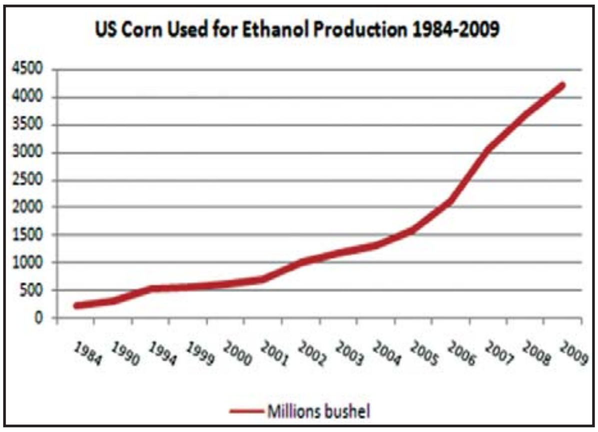

Figure 3: US Corn used for Ethanol Production 1984-2009 (Sources: USDA, 2010)

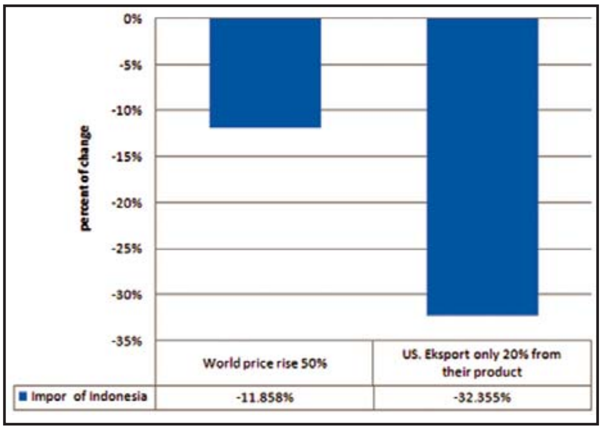

Figure 4: Estimated of Indonesia Corn Import at The Event of External Shock (Simulation analysis)

countries, especially in the European Union and Latin America jointly develop bio-ethanol industry. (Figure 3).

Simulation aims to analyze the impact of various changes in the exogenous variables. However, before doing the simulation, model validation must be done to look at the suitability of the predicted value in accordance with the actual value of each endogenous variable (Pindyck and Rubinfield, 1991).

Table 2 presents the results of the validation of the economic corn model. Based on Table 2 can be found, only three equations in the model has a RMSPE value of more than 50 percent, only one equation is greater than 100 percent and the rest have RMSPE value of less than 50 percent. U-Theil criteria there are 13 equations have a U value of less than 0.20, and 5 the equation has a value of U between 0.24 to 0.50. The highest value of the Theil-U in the equation is 0.5, and RMPSE value greater than 100 percent, is owned by the Indonesian corn price equation but there is no systematic bias, because the value of Um more than 0.20. Overall, this model is suitable for use as predictive models, so the structural model has been formulated which can be used for various simulations.

Simulation is used with the assumptions: (1) climate anomalies lead the world corn prices rose 50 and the energy crisis that caused the corn used as feedstock for ethanol, as a result the world corn prices rose 2.9 percent. Ex ante analysis for simulation model presented in table 3. Based

Table 2: Result of Validation Dynamic Econometric Models

No.	Variable	RMSPE	Reg (UR)	Var (US)	Covar (UC)	Coef U
1	AJ	0.5904	0.02	0.04	0.76	0.0028
2	PRJ	11.6864	0.02	0.02	0.00	0.0558
3	DIP	1.8582	0.01	0.00	0.37	0.0089
4	DIL	22.8999	0.00	0.00	0.00	0.1293
5	DK	38.9767	0.05	0.06	0.00	0.2509
6	MIAS	52.9878	0.99	0.62	0.37	0.2636
7	MICH	65.7784	0.25	0.11	0.14	0.4613
8	MITH	24.6001	0.14	0.00	0.14	0.1445
9	PJ	262.4	0.07	0.00	0.07	0.5018
10	PWJ	37.3681	0.08	0.08	0.00	0.2411
11	XAS	7.4399	0.22	0.22	0.00	0.0399
12	XTH	30.5445	0.10	0.10	0.00	0.1909
13	XCH	21.8008	0.00	0.00	0.00	0.1226
14	MJJ	3.0589	0.07	0.01	0.06	0.0150
15	MJK	0.3193	0.08	0.08	0.00	0.0016
16	DIT	16.9178	0.01	0.01	0.00	0.0926
17	QJ	12.0027	0.03	0.03	0.01	0.0574
18	MIT	30.1795	0.59	0.18	0.41	0.1761

Source: Research findings.

Table 3: The Ex-Post Analysis for Simultaneous Simulation

Variable	Base	World price rise 50%	US. Export only 20% from their product
AJ	2156142	2156584	2157446
PRJ	5.4348	5.4348	5.4348
DIP	5338632	5335799	5330258
DIL	6838667	6828066	6807336
DK	842862	841017	837408
MIAS	345879	338761	0
MICH	150932	103884	141042
MITH	119420	52425.8	117113
PJ	24919.9	25002.2	25162.9
PWJ	160.9	240	165.6
XAS	52286034	50281511	9242391
XTH	534673	704465	544645
XCH	6605682	6090199	16681027
MJJ	17055710	16344914	17013965
MJK	9501793	9483296	9500706
DIT	13020161	13004881	12975002
QJ	11747862	11750272	11754655
MIT	1106718	985558	748642

Source: Research findings.

on analysis can be show that the food crisis due to climate anomalies lead the world corn prices rose 50 percent impact on Indonesia corn imports fell by 11.86 percent. While the energy crisis that caused the corn used as feedstock for ethanol, causes U.S. limit maize exports only 20 percent of their products have an impact on corn imports Indonesia fell 32.4 percent. (Figure 4)

Ex-post simulation analysis results indicate that both the external shock of climate change and bio-ethanol conversion have an impact the decline in the amount of corn traded in world markets, and this has also impacted on the decline in imports of corn Indonesia. Based on the decrease in the value from the two simulations shows that the U.S. has a significant role in Indonesian corn economy, where if the U.S. lowered its export causes a considerable impact for more decline in Indonesia imports. This indicates Indonesia has a large dependence on the U.S for maize domestic supply, therefore the need for policy in terms of increased productivity and the expansion of planting area by utilizing the technology package and the existing land use to reduce dependence on other countries.

CONCLUSION AND RECOMMENDATIONS

The main objective of this study was to knows the impact of bio-ethanol development and global climate change on the economic performance of corn in Indonesia. This study used the annual time series data (1983-2010) and use a dynamic simultaneous equations system.

Ex- post simulation analysis results show that climate change, bio-ethanol conversion as a major determinant of import corn Indonesia. The results of simulation analysis of global climate change and the conversion of corn for bio-ethanol have an impact on the fall to import corn in Indonesia. This situation is expected to increase competitive advantage and comparative of Indonesian corn farming. Nevertheless there are still many problems faced by Indonesia such as corn farm land issues, technology, human resources, capital, fertilizer; rural infrastructure; and distortion distribution.

Some policies that are needed include (1) the expansion of planting area by increasing cropping index (IP) and extensification by making use of idle land, (2) suppress the difference in results between regions and agro-ecosystems through the use of new high yielding varieties and hybrid composites as well as site-specific application of the PTT model, (3) suppress the loss of the harvest and post harvest, and (4) increase the stability of the results between seasons and regions through the implementation of integrated pest management wisely. (5) human resource development of farmers through Farmer Field Schools (human capital) and also involve farmers in innovation (joint innovation), (6) institutional development (social capital) farmers as Farmer Field School activities continued; (7) irrigation infrastructure investment and drainage are more flexible (physical capital), and (8) investment in infrastructure and rural economy.

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Determinants of Repayment of Loan Beneficiaries of Micro Finance Institutions in Southeast States of Nigeria

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Abstract

The study investigated the loan repayment, its determinants and socio-economic characteristics of microfinance loan beneficiaries in the Southeast states of Nigeria. It was carried out in three states of the five southeast states. Using a multistage sampling technique, a total of 144 loan beneficiaries in the three segments of MFIs, namely; formal (commercial and development banks); semi-formal (NGOs-MFIs) and informal (ROSCAS, "Isusu" and co-operative societies) were randomly selected and interviewed in the three states. An ordinary least square (OLS) multiple regression analysis was carried out to isolate and examine the determinants of loan repayment from the respondents' perspective. Results showed that beneficiaries had low level of education, operated enterprises at a relatively small scale, had large family size and were of middle age. Further, it was found out that the majority of the respondents were involved in farming enterprise (crop and poultry) even though trading was the most prominent single non-farming enterprise (trading, processing and artisanship). The result affirmed that the informal sector respondents recorded the best repayment rate, followed by the respondents of semi-formal and the banks brought the rear. Outstanding among the determinants of loan repayments from the respondents' perspective were; loan size, level of education, experience, profitability and portfolio diversity. These, therefore deserve special attention in loan administration of MFIs.

Keywords:
Determinants of Repayment of MFIs Loan Beneficiaries, Nigeria

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INTRODUCTION

Microfinance institutions are those institutions, which provide micro-credit, savings and other services to the productive poor. The focal point of many studies on microfinance dwells in the domain of poverty (Kanbur, 1987). Poverty is insufficiency of means relative to human needs (Encyclopedia Am, 1981). It is estimated that about 70% of Nigeria's population was poor and most of them live in rural areas and their major occupation is farming (CBN, 2002). Nigeria ranks as one of the 25 poorest countries in the world, having ranked 148 out of 173 countries surveyed (UNDP, 2002).

Inadequate infra-structural facilities, poor social services, low technical education, unstable growth patterns of the economy and neglect of agriculture, among other factors are largely responsible for the despicable poverty situation in Nigeria. The fall in the quality of life of Nigerians to a reasonable extent is traceable to the neglect of the agricultural sector and the overdependence of the oil sector. The role of small-scale farming in economic development of developing countries such as Nigeria is inestimable. Apart from providing employment opportunities to about 80% of rural population, they supply food, fiber and raw materials for the populace, local industries and exporters. Production is characterized by small size of land (often less than one hectare) and use of crude implements, poor yielding seedlings, inefficient techniques, poor storage facilities, low level of education, to mention but a few. All these cumulated to poor income and resilient vicious circle of poverty. Similarly, micro-enterprises suffer from income anemia and vicious circle of poverty of the owners.

There is concern that poverty reduction strategy (PRS) to date have tended to emphasize the public provision of goods and services (roads, water, etc) and paid less attention to productive sectors (Cabral Lidia, 2006). To break these chains of poverty, ensure food security and industrial growth of developing nations, there is need for increase investment in the agricultural sector by both the government and the farmers. It therefore becomes imperative to expand and strengthen the financial institutions to play catalytic roles in this regard, especially in the area of providing machinery and tools, improved inputs and farmers' education. Several studies, including Feijo (2001) and Oyeyinka and Bolalarinwa (2009) have identified the positive impacts of credit in the operations of rural farmers.

Unfortunately, the formal financial institutions, especially the banks that are equipped to carry out these functions shy away from financing these farmers, on grounds that they are high risk ventures and involve huge administrative costs. This provided the opportunity for the informal financial sector such as money lenders (with its obnoxious interest rates), local co-operative societies, credit unions and thrift schemes that are less equipped to carry out this intermediation function, to key in and intensify credit delivery functions. Confirming this, the Central Bank of Nigeria (2005) noted that the formal financial system provides services to about 35% of the economically active population while the remaining 65% are excluded from access to financial services. According to the apex financial body, these 65% are often served by the informal sector through NGO-MFIs, friends, relations and credit unions.

Surprisingly, these informal institution apart from their high cost of credit, are performing exceedingly well in terms of loan repayment (which is the nightmare of formal financial institution). Also, their strong attribute is fast and efficient credit delivery with much less bureaucracies like collaterals which is replaced with trust and faith.

Loan repayment has been a critical problem of formal financial institutions in Nigeria. Studies in Imo State by Njoku and Odii (1991) recorded 27% repayment rate of the farmers, Njoku and Obasi (2001) in which 33.72% was recorded as repayment rate. This situation weakens the virility of the MFIs. According to CBN (2005), the weak capital base of the existing financial institutions, particularly the community banks (now transformed to micro finance banks), cannot adequately provide a cushion for the risk of lending to farmers and micro entrepreneurs without collateral. Further, poor repayment rate of credit reduces lenders net return thereby decreasing the ability of the institution to generate resources internally for institutional growth. In extreme cases, this may result in distress condition or outright liquidation of the institution. Besley (1994) affirmed that the issue of enforcing repayment constitutes a major problem in credit market. According to the author, enforcement problem arises in a situation in which the borrower is able but unwilling to repay the loan.

One way to tackle the loan repayment problem is to investigate the factors which affect the loan repayment of MFIs. Eze and Ibekwe (2007) in their study on determinants of loan repayment in Orlu Local Government of Imo State, South-east, Nigeria, identified; loan size, age of beneficiaries, household size, and number of years of formal education and occupation as the key determinants. Similarly, Dayanandan and Weldeselassie (2008) in their study on loan determinants of small farmers in Northern Ethiopia, agreed with Eze and Ibekwe (2007) that amount of credit, educational status and occupation (non-farm income) were potent factors in loan repayment. Other factors they isolated as potent were; experience, repayment period and ownership of livestock.

This study is aimed at providing answers to the hydra-headed repayment problem. It is reasonable to expect that an impressive loan repayment would be mutually beneficial to both the farmers/micro-entrepreneurs and the loan institutions. On the part of the farmers and micro entrepreneurs, good credit ratings would definitely attract more loans with which to procure improved inputs and implements. In such situation, efficiency would improve as well as profitability and these are capable of lifting them out of the vicious circle of poverty. For the financial institutions, which depend mainly on interest income for their institutional growth, prompt loan repayment would mean reduced cost and enhanced profitability and robust growth.

Therefore, the broad objective of this paper is to determine factors affecting repayment rate of loan beneficiaries of MFIs in the Southeast States of Nigeria. The study specifically investigated the social-economic characteristics of the respondents; determine their loan repayment rate and its determinants.

MATERIALS AND METHODS

The study was carried out in Southeastern states of Nigeria comprising of Abia, Anambra, Ebonyi Enugu and Imo States. The area had a population of 25.9 million, which is about 30% of the national population (2006). The Southeast states are among the mostly densely settled area of the country, with average population density of 247 persons per square kilometer as against the national average of 96 persons per square Kilometer (NPC, 2006).

The choice of the area was because of intense activities of self help groups in various economic activities, including agriculture in the area. Also, there is a high degree of socio-cultural homogeneity in the study area as the inhabitants are mainly Igbos, known mainly for their hard work, self-reliance and economic prowess.

Multi-stage sampling technique was employed in the selection of respondents who were mainly loan beneficiaries of commercial, development, community (micro finance) banks, NGO-MFIs groups and the local Isusu, co-operatives, ROSCAS members. The sample frame was provided by the Central Bank of Nigeria for NGO – MFIs; the banks and the local extension agents of the local government council.

In stage one, three out of five south-east states were purposively selected based on intensity of MFIs activities.

Stage two involved the selection of MFIs, which were stratified into formal, semi-formal and informal. From each stratum, four institutions were selected randomly. Thus, giving a total of 12 MFIs per state and 36 MFIs for the three states selected.

Finally, from each of the 12 MFIs in a state, four respondents were selected, randomly. Thus, giving a total of 48 respondents per state, and 144 respondents for the three states, representing the south-east states. The respondents were selected from 28 out of 57 LGAs of the three states and this represented about 49% coverage of the total number of the LGAs. The 28 LGAs came into the sample by chance factor as no deliberate effort was made to choose them.

From the selected respondents, which involved five enterprise-types namely; crop and poultry farmers, traders, agro-processors and artisans; calibrated as farming and non-farming activities. Primary data were collected with the aid of a structured and pre-tested questionnaire. The secondary data were collected from journals, textbooks, annual accounts, return from banks, UNDP and CGAP (the consultative group to assist the poorest) websites.

The data collected were subjected to both descriptive and quantitative techniques, to realize the objectives of the study. The OLS multiple regression analysis was used to determine factors which affected repayment rate of loan beneficiaries. The linear functional form was adjudged the most appropriate for a repayment function. The model is stated as follows:

$Y = f(X_1, X_2, X_3---X_{13}, e)$

Y_1 = Repayment rate (%)

X_1 = Loan size (N)

X_2 = Dependency ratio (children as percentage of total households size)

X_3 = Level of education (year of formal education)

X_4 = Age (years)

X_5 = Enterprise type (dummy variable: farming enterprise =o, and non farming enterprise = 1)

X_6 = Experience (years)

X_7 = Profitability of respondents enterprises (N)

X_8 = Training (total no. of days per year)

X_9 = Interest rate (%)

X_{10} = Repeat loan (%)

X_{11} = Gender factor (percentage of group members who are female)

X_{12} = Shocks (No. of family emergencies, crop/income loss due to incidence of pests and diseases, major social events that occurred in the previous 18 months)

X_{13} = Portfolio Diversity (proportion of members that have secondary occupation).

e = error term.

Table 1(a): Distribution of the mean values of some economic indices of the respondents

Socio-economic Characteristics	Mean Value
Majority of sex: female	63
Marital Status	80
Family size	10
Age (years)	41
Experience (years)	8.8

Table 1(b): Distribution of Number of Years Spent in School

No of Years Spent in School	Frequency	%
None	43	29.9
1 – 6	31	21.5
7 – 12	46	31.9
13 -16	24	16.7
Total	**144**	**100.0**

Table 1(c): Distribution of Primary Occupation

Occupation	Frequency	%
Trading	48	33.3
Crop farming	41	28.5
Agro – processing	17	11.8
Poultry farming	27	18.8
Poultry farming	11	7.6
Total	**144**	**100.0**

RESULTS AND DISCUSSION

Socio-economic characteristics

The socio-economic characteristics are important sign posts in explaining the behaviour of the farmers and micro entrepreneurs in certain actions such as management and loan repayment decisions. They complement the results of the technical or quantitative analysis such as OLS multiple regression. Some of these characteristics are summarized in the tables.

Table 1(a) is the distribution of the mean value of some economic indices of the respon-

Table 1(d): Distribution of respondents by enterprises size (turnover: Naira for traders, agro processors and artisans)

Class	Frequency	%
Less than 20,000	1	1.32
21,000 -51,000	2	2.64
52,000 – 82,000	2	2.64
83,000 – 113,000	10	13.15
114,000 – 113,000	10	13.15
114,000 – 144,000	21	27.63
145,000 – 175,000	18	23.68
176,000 – 206,000	12	15.79
Greater than 206,000	10	13.15
Total	**76**	**100.0**

Table 1(e): Distribution of poultry farmers by enterprises size (stock of birds)

Class	Frequency	%
less than 50	1	3.7
51-101	15	55.6
102 -152	8	29.6
152-203	2	7.4
Greater than 203	1	3.7
Total	**27**	**100.0**

Table 1(f): Distribution of crop farmers by farm size (hectare)

Class	Frequency	%
01 or less	12	29.27
0.2 -0.4	18	43.90
0.5-0.7	7	17.07
0.8-1.0	3	7.32
Greater than 1.0	1	2.44
Total	**41**	**100.0**

dents. The majority of the respondents (63.2%) were female and male constituted only 36.8 percent. Eighty percent of the respondents were married and by implication were likely to have families, while 20% were single. On age, about 55% of the respondents were of middle age bracket and above, with about 45% being youths. The respondents have relatively large family with 10 as mean family size as against the recommended national figure of six. Over 70% of the respondents had eight years and above in experience in work with a mean figure of 8.8 years.

Table I (b) is the distribution of the respondents by level of education. It showed that about 70% of the respondents are literate and about 30% were not literate. This suggested that education was still a problem. Literacy level impacts positively in productivity and efficiency of farmers through adoption of technology and innovations.

Table 1(c) is the distribution of respondents by primary occupation. It suggested that trading was the primary occupation of the greatest number (33%) of the respondents. However, on the aggregate, farming constituted about 60% of the respondents' primary occupation while non-farm enterprise constituted about 40%. About 40% of the non-farming respondents have farming as secondary occupation.

Tables 1(d), (e) and (f) are the distribution of respondents by enterprise size (Naira) for traders/processors/artisans; stock of birds for poultry farmers and farm size (hectares) for crop farmers, respectively. Table 1(d) showed that over 71% of the respondents had a turnover of less than N144, 000 per annum. This suggested that the respondents were of low income group. Table 1(e) showed that over 80% of the poultry farmers had not more than 152 birds in their stock. The mean stock of birds for these farmers was 102 birds suggesting small-scale operations. Table 1(f) showed that over 90% of the crop farmers owned or cultivated not more than 0.7 hectares of land. The mean size of farm of the respondents was 0.46 hectare, suggesting that they were operating mainly on a small-scale.

Table 2: Distribution of Respondents by Sources of Loans

Class	Frequency	%
Co-op Soc.	17	11.8
NGO/MFIs	53	36.8
Commercial Banks	15	10.4
ROSCAS	24	16.7
DFI (NACRDB)	21	14.6
Community Banks (MFBs)	14	9.7
Total	**144**	**100.0**

Sources of Loan and Repayment Rate

Table 2, showed the distribution of respondents according to sources of their loan. The NGO-Microfinance Institutions provided loan to 38.8% of the respondents. This was followed by Rotation Savings and Credit Association (ROSCAS) (16.7%), NACRDB (14.6%), co-operative societies (11.8%), commercial banks (10.4%) and Community Banks (or Microfinance Banks) (9.7%).

On loan repayment, this was segmented into prompt repayment (for those repayments that were effected as scheduled) and overall repayment (for those repayments that were effected not as scheduled and of course, which involved recovery costs on the part of the financial institutions) as indicated on Table 3(a). On prompt repayment, the respondents of informal institutions recorded an average of 90%, repayment rate followed by

Table 3: Loan Repayment of Respondents

Enterprise (or MFI Category)	Frequency	Repayment(%)	
		Prompt	Overall
a) MFI Categorization			
Formal	12	43.04	56.58
Semi- Formal	12	73.57	84.91
Informal	12	90.00	100.00
b) Enterprise Type			
Crop Farming	41	55.47	
Poultry Farming	27	41.20	48.33 (AV.)
Trading	48	78.78	
Agro-processing	17	70.79	
Artisans	11	61.50	70.35 (AV.)

Table 4: Distribution of Respondents by reasons for Default

Item	Frequency	%
Item	17	11.8
Poor harvest due to crop failure	10	7.0
Low market price	41	28.5
Incidence of Pest and Diseases	24	16.3
Untimely loan disbursement	19	13.2
Family commitments	50	35.0
	144	**100.0**

semi-formal institutions (NGO-MFIs) 73.57% and formal institutions (banks) 43.04%. On overall repayment, the respondents of informal financial institutions recorded 100% repayment rate. This was followed by semi-formal institutions 84.91% and formal institutions 56.58%. Table 3(b) indicated that the respondents in trading repaid about 79% of their loan promptly. This was followed by agro-processors (about 71%). In general, non-farming enterprises on the average repaid about 70% of their loan as against 48% of farming enterprises. This could be attributed to the complex and risky nature of farm enterprises.

Table 4 showed the reasons for default. It showed that family commitments ranked highest (35%) among the reasons adduced for default. This was followed by low market prices (28.5%), incidence of pests and diseases (16.3%), untimely disbursements (13.2%) and crop failure (7%). Family commitments (like school fees, extended family problems, burial and other cultural ceremonies) were a big burden on the respondents as well as low market prices, especially during harvest, occasioned mainly from lack of poor storage facilities.

Determinants of Loan Repayment of Respondents

Table 5 showed the factors, which affected loan repayment and were calibrated as determinants of loan repayment. It indicated that out of 13 explanatory variables, five were the most potent factors. The Coefficient of Multiple Determination (R^2) was 0.5022, suggesting that about 50% in the variation of loan repayment was accounted for by the variations of the explanatory variables. This suggests that there may be other factors not included in the model. If $R^2 = 1$, it implies that there was 100% explanation of the variation in loan repayment by the explanatory variables or regessand. However, if $R^2 = 0$, it means that the explanatory variables do not explain any changes in the criterion vari-

Table 5: Determinants of Loan Repayments of Respondents:

VARIABLE	UNIT	COEFFICIENT	T-RATIO
Loan Size	Naira	12.0318	2.9272*
Dependency ratio	Percent	-7.1043	-1.1422
Level of education	Years	15.9122	2.6372*
Age	Year	-6.0359	-1.0751
Enterprise type	Dummy	8.2134	1.0359
Experience	Years	10.4494	3.3368*
Profitability Index	Number	17.0318	4.0632*
Training period	Days	9.4227	1.1725
Interest rate	Percent	-5.0389	-1.2260
Repeat loan	Dummy	9.1163	1.1339
Gender factor	Percent	11.0295	1.0870
Shocks	Likert Ranking	-15.0214	-1.0019
Portfolio diversity	Dummy	6.9943	3.3928*
Constant	39.9133		
R2	0.5022		
F-value	10.0884		
N	144		
d.f.	130		

LOS = *5%

able or loan repayment. The F-value is used to test whether or not there is significant impact between the dependent variable and the independent variables. In regression equation, if F-calculated is greater than F-tabulated, then there is significant impact between the dependent variable and the independent variables. If otherwise, the reverse is the case.

The five potent variables which affected loan repayment were; loan size, level of education, experience, profitability and portfolio diversity and they are subsequently discussed.

(a) Loan Size

Loan size was significant at the 5% LOS and was positively related to repayment rate. This implies, the greater the size of the loan, the lower the default. This was true up to a certain point as there was an optimum amount of loan (or funds) that would be required to break even in projects. Moreover, it is contended that bigger loans make possible larger investments with potentially higher returns. About 75% of the loan beneficiaries indicated that the sizes of their loans were inadequate, thus supporting this viewpoint. Also, Njoku and Obasi (2001) isolated loan size, among two other variables, that are important and have positive relationship with loan repayment under ACGFS in Imo State.

Similarly, Olagunju (2007) in his study on the impact of credit use, agreed with this view point. However, Zeller *et al.,* (2001) in their study of group based financial institutions for the rural poor in Bangladesh found out that the greater the loan size, the greater the probability of default.

The second perspective to this variable was the larger the loan, the

higher is the borrower's cost of delaying payment. A larger loan is more difficult to repay if allowed to accumulate especially where there are compounding interest and sanctions. This second factor puts pressure on the borrower to reduce late payments and serious default. In the sample, recorded incremental penalty rate of interest for delay payment was minimal.

(b) Level of Education

The level of education was significant at the 5% level, and was

positively signed as hypothesized. This suggests that as the level of education improved the beneficiary also improved the ability to read and write and in the process, improved dexterity in the occupation, which concomitantly improved profit and the capacity to repay loans. This is in agreement with Coelli and Battese (1996) in India.

respondents were 6.4 while the figure for non literate respondents was 30%, which suggested that there were lots of room for improvement in their education status.

(c) Experience

The coefficient of experience was positive and significant at 5% level suggesting that the length of experience in occupation was a potent factor in loan repayment. This was because experience provided the compass with which the entrepreneur navigated the turmoil business environment and was a veritable decision tool. The result and that of Parikh and Mirkalan (1995) supported this hypothesis. The respondents had eight or more years in terms of business experience. However, Ogundare (2009) reported a negative coefficient of age and farming experience, which implies that output decreased as each of these variables increased. It suggests that the more the years of experience of the farmer and by implication, the older in age and the less productive and the tendency of increasing risk aversion.

(d) Profitability

The coefficient of profitability index was positive and significant at 5% level and was in consonance with hypothesis, which stated that profitability index (ratio of income to costs) had direct and strong relationship with repayment. This was because difficulties in repayment arose whenever a business in unprofitable. It is an indication or index of management ability. In the event of not making profit, enterprises including NGOs (which are expected to break-even), become unsustainable.

(d) Portfolio Diversity

This indicates the proportion of beneficiaries who have secondary occupation. It is therefore an indicator of asset portfolio diversity within the group/respondents. The study showed that the majority (66%) of the respondents have trading as their secondary occupation. Due to diversity, income within groups tended to be less covariant, thus making it easier to bail out errant members. As hypothesized, the coefficient of the variable was positively signed and significant at 5% level, indicating strong relationship.

The linear equation can generally be represented thus:

Y1 = 39.9133 + 12.0318X1 – 7.1043X2 + 15.9122X3 – 6.0359X4 +
(2.93*) (2.64*)
8.2134X5 + 10.44946 + 17.0318X7 + 9.4227X8 – 5.0389X9
(3.34*) (4.06*)
+9.1163X10 + 11.295X11 – 15.0214X12 + 6.9943X13 + 6.0038
(3.39)*

R^2 = 0.5022 F-Value = 10.0884 *1%LOS

CONCLUSION

The respondents are certainly micro/small scale operators with low income, poor educational background and relatively large family size and its attendant burden and challenges. The respondents were of middle age and females were predominant. Farming was the main occupation and trading constituted a third of the respondents' occupation. Nevertheless, half of the trading respondents have farming as their secondary occupation.

The major source of their loans were the informal sector namely; NGOs-MFIs and ROSCAS. The respondents of the informal sector performed most creditably in terms of loan repayments. This was followed by the semi-formal (NGOs-MFIs) and the banks brought the rear. This perhaps may be due to the fact that screening, monitoring and enforcement of payment were carried out by the group members themselves. In terms of enterprise type, trading was found to be the most important with respect to loan repayment. This was followed by agro-processors and artisan (others). Crop and poultry farming brought the rear. In general, non-farming enterprises performed better than farming enterprises in terms of loan repayment. The difference could be attributed to the complex and risky nature of farming, hence the need for extra ordinary support for farming enterprises.

In terms of loan administration and repayment, adequate attention should be paid to loan size, level of education, experience, profitability, portfolio diversity. These constituted the determinants of loan repayment from the respondents' perspective and therefore deserve more focus and attention.

Further, formation of autonomous cooperative societies, provision of storage facilities and reduction of some associated expenses that affect family commitments (e.g. school fees) will help reduce loan default.

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Analysis of Technical Efficiency of Smallholder Cocoa Farmers in Cross River State, Nigeria

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Abstract

The technical efficiency involved in cocoa production in Cross River State was estimated using the stochastic frontier production function analysis. The effects of some selected socio-economic characteristics of the farmers on the efficiency indices were also estimated. The study relied upon primary data generated from interviewing cocoa farmers using a set of structured questionnaire. A multi-staged random sampling technique was adopted in selecting two hundred (200) cocoa farmers from Ikom Agricultural Zone in the state. The data on the socio-economic characteristics of the farmers were analyzed using descriptive statistics, while the stochastic production function, using the Maximum Likelihood Estimating (MLE) techniques was used in estimating the farmer's technical efficiency and their determinants. Result of the analysis showed that farmers were experiencing decreasing but positive returns to scale in the use of the farm resources. The efficiency level ranged between 0.20 and 0.93 with a mean of 0.69. The result of the generalized Likelihood Ratio (LR) tests confirmed that the cocoa farmers in the area were technically inefficient. The major contributing factors to efficiency were age of farmers, farm size, level of education, sex of farmer and age of the farms. The study observed that there is enough room to improve efficiency with the farmers' current resource base and available technology and concluded that policies that would directly affect these identified variables should be pursued.

Keywords:
Cocoa production, Technical efficiency, Stochastic frontier, Likelihood ratio, Maximum likelihood ratio

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INTRODUCTION

Agriculture in developing countries is characterized by low productivity leading to low farm incomes. In Nigeria, cocoa production is characterized by several problems that lead to low productivity. This has resulted to a fall in percentage share of cocoa output. As Amos (2007) notes, two reasons are said to be responsible for the fall in percentage share of cocoa output. First is the negligence of the agricultural sector by the past administration due to the discovery of the petroleum resources that now accounts for the bulk of foreign exchange earnings. Second is the endemic problem in the cocoa industry. Therefore, increasing productivity will increase the percentage share of cocoa production. Analysis reveals that increasing agricultural production has probably been the simple most important factor in determining the speed and extent of poverty reduction. Most of these evidences are derivable from the Green Revolution in Asia (Adeniran, 2007). In China rapid productivity gains achieved largely through technological advances of the Green Revolution directly increased producers income and labourers' wages by lowering the price of food and by generating new livelihood opportunities as success in agriculture provides the basis for economic diversification. The importance of productivity is that it gives a measure for efficiency.

In Nigeria, there have been studies on farm level efficiency in tree crop production and very few have focused on cocoa production. Among these are studies by Giroh *et al.,* (2008) who carried out analysis of the technical inefficiency of gum Arabic based cropping patterns among farmers in the gum Arabic belt of Nigeria and that of Amos (2007) whose study is analysis of productivity and technical efficiency of small holder cocoa farmers in Nigeria. The authors employed the stochastic frontier production function analysis in their studies. However we do not have such studies in Cross River State which is a major cocoa producing area in Nigeria. Recent studies carried out on cocoa production in Cross River State examined the Socio-economic variables and cocoa production (Oluyole and Sanusi, 2009). Fertilizer use and cocoa production and Investment in cocoa production in Nigeria: .A Cost and Return analysis of three cocoa production management system in Cross River State cocoa belt by Nkang *et al.,* (2009). None of these studies examined the technical efficiency of the cocoa farmers.

Objectives:

This study was carried out to provide estimates of levels of technical efficiency of cocoa farmers in Cross River State using farmers in Ikom Agricultural zone, where there is a high concentration of cocoa farmers in the state. The study was interested in whether the cocoa farmers were fully technically efficient, the current level of efficiency and factors that influenced efficiency. The study therefore was to estimate the level of and determinants of technical efficiency among cocoa farmers in Cross River State.

MATERIALS AND METHODES

Study area

This study was conducted in the two major Cocoa Producing Local Government Areas in Cross River State; Etung and Ikom. Cross River State is located in the Niger Delta region of Nigeria. It is bounded in the North by Benue State, in the South by Atlantic Ocean, in the East by Cameroon Republic and on the West by Akwa Ibom State, Abia and Ebonyi States. The state lies within latitude 40^o 4, South and 60^o30, North and between longitude 8^o and 9^o 00" East of the equator. It has three distinct ecological zones, the mangrove forest to the south, the tropical rainforest in the middle and the guinea savanna to the north. The annual mean rainfall ranges between 1500mm and 2000 mm.

Sampling procedure and sample size

The multistage random sampling technique was adopted for this study. The first stage involved a purposive selection of two (2) Local Government Areas in the Ikom Agricultural Zone- Ikom and Etung. This is because Ikom and Etung are the major cocoa producing areas in Cross River State. The second stage involved the random selection of Five (5) villages from each of the selected Local Government Areas, giving a total of Ten (10) villages. The villages selected in Ikom were Akparabong, Ayukasa, Okondi, Alok and Ajassor, while those selected in Etung were Effraya, Agbokim, Bendeghe Ekim, Abijang and Abia. A simple random selection of twenty (20) farmers from each of the selected villages was carried out making up a total of one hundred (100) farmers from each of the two Local Government Areas which gave us 200 cocoa farmers for the study. Information was obtained on socio-economic characteristics of the farmers, output, labour, farm size and prices of variables using a set of structured questionnaire.

Model specification

Descriptive statistics including mean, standard deviation and variances were used to analyse the socio-economic characteristics of farmers while the stochastic production function was used to analyze the level of technical efficiency. The production technology of the cocoa farmers was assumed to be specified by the Cobb-Douglas frontier production function (Tadesse, and Krishnamorthy, 1997; Amos, 2007).

The specified cocoa production function was given as follows;

$$\text{In } Y = \text{In } \beta_o + \beta_1 \text{In} X_{1i} + \beta_2 \text{In} X_{2i} + \beta_3 \text{In} X_{3i} \ \beta_4 \text{In} X_{4i} + V_i - U_i \qquad (1)$$

Where;

Y = Quantity of cocoa produced (kg)

X_1 = Farm size (hectares)

X_2 = Quantity of fertilizer (kg)

X_3 = Quantity of fungicide (litres)

X_4 = Labour (man days)

B_o = Y - intercept

B_1 to β_4 are coefficients to be estimated and V_i and U_i are error terms. It is expected that β_1, β_2, β_3, and β_4 will have positive signs.

Determinants of technical efficiency

The influence of some socio-economic factors on the computed technical efficiency was determined by incorporating the socio-economic factors directly in the frontier model, because they have influence on efficiency (Kalirajan, 1981). The technical efficiency model was specified as:

$$Ui = ąo + ą1Z1í + ą2Z2í + ą3Z3í + ą4Z4í + ą5Z5í + ą6Z6í + ą7Z7í \qquad (2)$$

Where

U_i = Technical efficiency

Z_1 = Sex of farmer (dummy)

Z_2 = Marital status (dummy)

Z_3 = Age of farmer (years)

Z_4 = Education (years spent in school)

Z_5 = Family size

Z_6 = Age of farm (years)

Z_7 = Farm size (ha)

$ą_o$ = y - intercept

$ą_1$ to $ą_7$ are coefficients that were estimated. It was expected that $ą_3$ would have a negative sign, while $ą_2$, $ą_4$, $ą_5$, $ą_6$ and $ą_7$ would have positive signs. The sign of ą1 was indeterminate.

In determining the level of technical efficiency of the cocoa farmers and analyzing the determinants of technical efficiency among the cocoa farmers, a generalized likelihood ratio (LR) test was used to test the hypothesis of full technical efficiency effects defined as

$$LR = -2 \text{ In } (\log H_1 - \log H_2) \qquad (3)$$

Where, H1 is the log – likelihood function of the average function. H2 is the log- likelihood function of the frontier function. The value has a mixed chi-square distribution with degrees of freedom equal to the number of parameters plus one. A computer programme frontier version 4.1 by Coelli (1994) was used in the computation, while the testing of the parameters was done at 1 and 5 percent levels of significance.

RESULTS AND DISCUSSION

Socio-economic characteristics of the sampled cocoa farmers

The distribution of sampled cocoa farmers according to their sex, age, marital status, educational level, family size and farming experience is presented in Table 1. The results indicates that majority (88.5%) of the farmers were males while few (11.5%) were females. The cultural setting of the area allows the males to have easy access to land especially, where majority of them are the heads of their respective households.

The table also indicates that majority of the farmers (44.5%) were within the 47 to 57 years age bracket. This was closely followed by the farmers with age 36-46 years (32%). Farmers that were in the minority constituted 1.5% and these farmers were above the 68 years age bracket. This shows that about 86% of the farmers were in their most economically active age bracket (25-57) years. However, there was a widespread of farmers among all the age groups, implying that cocoa farming was embraced by all the age groups. The results also showed that most of the farmers (68.5%) were married while 31.5% were single (Table 1).

Furthermore, the distribution of the cocoa framers according to their educational level (number of years spent in school), shows that majority (76.5%) of the farmers had attained one level of formal education or the other. The mean level of educational attainment (years spent in school) of the farmers in the area was about 6 years, with 11% of the farmers having tertiary education. This is an indication that some graduates were involved in cocoa farming in the study area. This is a good pointer to improved productivity as the level of education is a tool with which an individual could be efficient at whatever endeavour being undertaken by the individual (Oluyole and Usman, 2006). As regards family size, a high proportion (86.5%) of the farmers had family sizes of 5 persons and above, while 13.5% had less than 5 persons in their household. The mean family size of the cocoa farmers was 7 persons. Effiong (2005) reported that a relatively large household size enhances the availability of family labour which reduces constraints on labour cost in agricultural production.

The table also shows that a very high proportion (99%) of the farmers had between 5 and above thirty (30) years of experience in cocoa farming. The mean farming experience was about 15 years. Farmers sometimes count more on their experience than educational attainment in order to increase their productivity (Nwaru, 2004). The result implies that a good number of the farmers are experienced farmers and therefore are expected to have higher technical efficiencies.

Mean output and other production variables in cocoa production in Cross River State

The statistics of the production variables obtained from cocoa farmers in the study area are summarized in table 2. The mean output of cocoa farmers in the area was 2428.10kg/annum/farmer. This is relatively high compared to figures of less than two tonnes recorded elsewhere. This may be related to the age of the farms as most farms in Cross River State are within the productive age of 11 to 40 years (Table 3) compared

Table 1: Distribution of socio-economic characteristics of sampled cocoa farmers

Variables	Frequency	Percentage
Sex:		
Male	177	88.5
Female	23	11.5
Total	200	100
Age of farmer (years):		
25 – 35	19	9.5
36 – 46	64	32.0
47 – 57	89	44.5
58 – 68	25	12.5
>68	3	1.5
Total	200	100
Means	47.70 (8.91)	
Marital status:		
Single	63	31.5
Married	137	68.5
Total	200	100
Mean	2.02(1.61)	
Educational level (school years):		
0	47	23.5
6	81	40.5
8	14	7.0
12	36	18.0
14	14	7.0
16	8	40
Total	200	100
Mean	6.45 (4.49)	
Family size:		
<5	27	13.5
5 – 7	76	38
8 – 10	54	27
11 – 13	24	12
14 – 16	9	4.5
17 – 19	7	3.5
>19	3	1.5
Total	200	100
Mean	7. 11 (4.66)	
Farming experience (years)		
<5	2	1.0
5 – 10	74	3.7
11 – 15	54	2.7
16 – 20	33	16.5
21 – 25	19	9.5
26 - 30	6	3.0
>30	12	6.0
Total	200	100
Mean	15.22 (7.70)	

Source: Field Survey 2010
Note: Values in parentheses are standard deviations.

Table 2: Summary statistics of output and other variables for sampled Cocoa farmers

Variables	Minimum	Maximum	Mean	Standard Deviation
Output (kg)	760.00	76200.00	2428.10	2343.53
Farm size (ha)	1.00	40.00	6.90	6.35
Fertilizer (kg)	0.00	200.00	18.50	37.09
Fungicide (litres)	0.00	2500.00	1142.80	644.37
Labour (man days)	18.00	93.00	51.49	14.65
Age of farmer (years)	25.00	71.00	47.70	8.91
Family size	1.00	26.00	7.00	4.66
Farming experience (years)	4.00	50.00	15.22	7.70

Source: Derived from Field Survey Data 2010

to farms in other parts of Nigeria. For labour, the mean man- days used by the farmer during the production season were 51.50 man days. Farm sizes in Nigeria have been described as small, medium or large scale, if they fall into categories of less than 5ha, between 5ha and 10ha, or more than 10ha, respectively (Upton,1972). Most of the farms in Nigeria are of small to medium scale categories. The average farm size among the cocoa farmers in the study area is 6.90 hectares scattered in different locations in the locality, hence the small holdings. It was observed that majority of the cocoa farmers in Cross River State did not use fertilizer in cocoa production. The mean fertilizer used by the farmers was 18.50, which is very low. The result is in line with Oluyole and Sanusi, (2009) which reported that 98.13% of cocoa farmers in Cross River State did not use fertilizer in cocoa production.

An average of 1142.80 litres of fungicide was applied by the cocoa farmers (Table 2). The high rate of application may be due to the less resistance of the cocoa variety to infection.

Classification of cocoa farmers according to age groups and their mean output in the study area

The sampled farms were grouped according to their age groups and mean output and majority (92%) of the farms are within the productive age of 11 to 40years age group (Table 3). The mean output initially increased within this age as the cocoa trees get fully established, and thereafter output declines as shown in the table.

Maximum likelihood estimates of stochastic production frontier function for cocoa farmers in Cross River State

The coefficient of the Maximum Likelihood Estimates (MLE) of the parameters of the stochastic frontier models of cocoa farmers is shown in Table 4. The variance parameters of the stochastic frontier production function are represented by sigma squared (δ^2) and gamma (y). From the table, the sigma squared is 0.171 and significantly different from zero at one percent level. This indicated a good fit and correctness of the distributional form assumed for the composite error term. Gamma (y) indicates that the systematic influences that are unexplained by the production function are the dominant sources of random error. The gamma estimate which is 0.327 and significant at five percent level shows the amount of variation resulting

Table 3: Age group of farmers and mean output

Age group	Frequency	Percentage	Mean output	Standard deviation
5 - 10	5	2.5	6305.2	6305.2
11- 20	81	40.5	8064.1	8064.1
21-30	81	40.5	8797.0	8797.0
31- 40	22	11.0	10448.0	10448.0
41- 50	8	4.0	7465.1	7465.1
>50	3	1.5	6573.0	6573.0
	200	**100**	**(2428.1)**	**(2428.1)**

Source: Field Survey Data 2010

Note: The values in parenthesis are the mean output and standard deviation of the farms respectively and do not represent the total mean output and standard deviation of the groups.

Table 4: Maximum likelihood estimates of the stochastic production function for cocoa production

Variable	Parameters	Coefficients	Standard errors	Standard errors
Constant	β_o	7.450	0.141	52.837***
Farm size	β_1	0.155	0.016	9.688***
Quantity of fertilizer	β_2	0.013	0.001	1.30
Quantity of fungicide	β_3	0.002	0.004	0.50
Labour	β_4	0.009	0.003	3.00***
Diagnostic statistics				
Gmma (Y)	Y	0.327	0.144	2.71**
Sigma square	δ_2	0.171	0.037	4.622***
Log likelihood function		-88.08		
Likelihood ratio (LR)	λ	71.42		

Source: Computed from Field Survey Data 2010 using Frontier 4.1
Note: *** P < 0/01, ** P < 0/05

from the technical efficiencies of cocoa farmers in the study area. This means that more than 32% of the variation in farmer's output is due to difference in technical efficiency.

The result further shows that the signs of all the estimated coefficients of the stochastic production frontier are positive which is consistent with a priori expectation. This implies that there is a positive relationship between the level of output of cocoa and farm size, the quantity of fertilizer, fungicide and labour used. This is expected as the level of production depends largely on the quantities of these inputs used on the farm. This can only be up to a level that is considered optimal after which farmers will be operating at sub optimal level. However, the coefficients of the slope, farm size and labour were significant at one percent indicating that farm size and labour are important determinants of cocoa output.

Determinants of technical efficiency in cocoa production

The analysis of the efficiency model shows that the signs of the estimated coefficients in the efficiency model have important implications on the technical efficiency of cocoa farmers in the study area. The coefficient of sex (z←←1) had a positive sign indicating that the male farmers obtain higher levels of technical efficiency than their female counterparts in the area. Cocoa farming is dominated by males in the area. This is so because cocoa farming is a tedious job and requires more strength which females may not be able to provide (Oluyole and Sanusi, 2009).

The coefficient of marital status (Z_2) is indeterminate. However, it is negative as shown in Table 5.

The coefficient of age (z_3) is also positive. This does not agree with a prior expectation. As farmers age, there is a tendency that productivity will continue to fall owing to their declining strength. However, this result could be attributed to the fact that most of the farmers in the study area started farming at early age. Hence, the older they are the more experienced and efficient they would be, since farmers' experience increases with the number of years spent in farm-

Table 5: Determinants of Technical Efficiency

Variable	Parameter	Coefficient	Standard error	t-ratios
Constant	a_o	-1.278	0.699	-1.828
Sex of farmer	a_1	0.009	0.415	0.022
Marital status	a_2	-0.209	0.135	-1.548
Age of farmer	a_3	0.011	0.136	0.801
Educational level (sch yrs)	a_4	0.054	0.204	0.265
Family size	a_5	-0476	0.236	-2.016**
Age of farm	a_6	-0.012	0.723	-0.017
Farm size	a_7	0.081	0.010	8.10***

Source: Computed from Field Survey Data 2010 using Frontier 4.1
Note: *** P < 0/01, ** P < 0/05

Table 6: Elasticity of production and returns to scale

Variables	Elasticity
Farm size	0.155
Quantity of fertilizer	0.086
Quantity of fungicide	0.420
Labour	0.094
RTS	0.179

Source: Field Survey, 2010

ing, it implies that the longer the time spent in farming the more experience they are.

Furthermore, the coefficient of educational level (z_4) was positive but not significant. This implies that the level of technical efficiency of the farmer increases with the level of education but not significantly. However, the result agrees with a prior that technical efficiency should increase with increases in years of schooling of the farmers since education and adoption of innovation were expected to be positively correlated.

The coefficient of family size (z_5) has a negative sign and is significant at the five percent level. This implies that increase in family size will lead to decrease in technical efficiency. This result does not agree with a prior expectation. However, given that the cocoa farmers utilized more of hired labour than family labour and less labour (weeding and pruning) is required once the cocoa has been established, it could be acceptable. The farmers pay wages that are more than the value of their marginal production and hence would be inefficient as a result of allocative inefficiency (Idiong, 2006).

The negative coefficient of age of farm (Z_6) implies that efficiency decreases as the farms get older. Amos, (2007) had a similar result. Lastly the coefficient of farm size (Z_7) was positive and significant at the one percent level. This implies that technical efficiency increases with the size of farm. This result agrees with those of Giroh *et al.,* (2008) and Amos (2007). Large farm sizes if properly managed should have higher efficiency. However, there is a threshold where returns to scale decreases with increase in farm size.

Elasticity of production and returns to scale

Typical of the power function (Cobb-Douglas), the estimated coefficients for the specified function can be explained as the elasticities of the explanatory variables.

The values of the variables indicates that a 10 percent increase in the size of farm, fertilizer, fungicide and labour will lead to a 1.5, 0.9,

Table 7: Test of hypotheses that cocoa farmers in Cross River State are fully technically efficient (У= 0)

Efficiency	Likelihood function (λ)	Log likelihood ratio (LR)	Critical X^2 0.05	Conclusion
Technical	-88.08	10.712	10.371	Reject

Source: Derived from Table 4. Critical X^2 was obtained from Kodde and Palm (1986).

Table 8: Frequency distribution of technical efficiency estimates

Efficiency level	Frequency	Percentage
0.20 – 0.30	2	1
0.31 – 0.40	3	1.5
0.41 – 0.50	20	10
0.51 – 0.60	17	8.5
0.61 – 0.70	38	19
0.71 - 0.80	91	45.5
0.81 – 0.90	26	13
>90	3	1.5
Total	200	100
Mean	0.69	
Minimum	0.20	
Maximum	0.93	

Source: Derived from output of the computer programme, Frontier 4.1 by Coelli (1994)

4.2 and 0.9 percent increase respectively in output of cocoa (Table 6). The value of the returns to scale (RTS) was 1.79 indicating that the farmers were operating in the region of decreasing but positive returns to scale (stage II of the production function). Therefore, increasing the units of inputs will not be the best option to the farmers as it will add less to total cocoa output (Table 7).

Technical efficiency estimates of the sampled cocoa farmers in Cross River Sate

The predicted farm specific technical efficiencies (TE) ranged between 0.20 and 0.93 (Table 8). The mean efficiency of the cocoa farmers was 0.69. The 69% mean efficiency indicates that in the short run, there is a scope of increasing cocoa production by about 31% by adopting the technologies and techniques practiced by the best cocoa farmers in the study area (Table 8).

The efficiency distribution also indicates that majority of the cocoa farmers (79%) were having efficiency of between 61% and 90% while a few of them (21%) were less than 60% efficient in their production process. The high levels of efficiency may be due to the long years of farming experience of the farmers.

CONCLUSION

This study reveals that, cocoa farmers in Cross River State are not fully technically efficient in their resource use. The policy variables that were identified as having significant effects (positive and negative) on the efficiency levels of the cocoa farmers are farmers age, family size, farm sizes, educational level, and age of the farm. It is believed that farmers' technical efficiency in resource use could increase since cocoa farmers in the area were not fully technically efficient; hence, there is room for improvement in the level of this efficiency if the important policy variables are addressed. Majority of farmers were in the productive age bracket and this was directly related to technical efficiency of cocoa farmers in the area. It is therefore important that a policy that would make cocoa farming attractive to persons within this age bracket. The 69% mean efficiency indicates that in the short run, there is a possibility of increasing cocoa production by about 31% by adopting the technologies and techniques practiced by the best cocoa farmers in the study area.

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Comparative Cost Structure and Yield Performance Anzlysis of Upland and Mangrove Fish Farms in Southwest, Nigeria

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Abstract

The bias against mangrove areas in siting fish farms prompted a comparison of the cost structure and yield performance in upland and mangrove locations. Tools utilized included descriptive statistics, budgetary and cash flow analyses and profitability ratios. Empirical results revealed that substantial revenue could be realized from both farms. While the upland farms yielded average gross revenue per hectare per year of $9,183.53, the mangrove farms made $8,135.93 revealing a slight difference. Results of combined cash flow and sensitivity analysis buttressed that of budgetary analysis. NPVs were $10,888.11 and $10,375.84, B/Cs were 1.28 and 1.29 and IRR were 48.55% and 48.51% for the upland and mangrove farms, respectively. Profitability ratios were also comparable but slightly higher in the upland farms. The conclusion is that there was little or no difference in yield performance. However, the high risk of investment loss in years of excessive flood should prompt investors in mangrove farms to compulsorily insure their farms.

Keywords:
Fish farming, Cost structure, Gross revenue,Investment yield, Upland and mangrove areas, Nigeria.

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INTRODUCTION

The widening demand-supply gap for fish in Nigeria attests to the fact that there is the need to explore all avenues to increase and sustain fish supply. The factors implicated in the demand-supply deficit situation include water pollution from perpetual oil spillages which results in dwindling catches from capture fisheries, constant upward reviews of the prices of petroleum products which depress profit from capture fisheries, and over-fishing which involves large quantities of by-catch sold along with target species (Mafimisebi, 1995, FAO 2000 and Delgado, *et al.,* 2003). A right step towards arresting the demand-supply deficit for fish is aquaculture, which involves raising fish under controlled environment where their feeding, growth, reproduction and health can be closely monitored. Such farm-raised fish is already accounting for a considerable and rising proportion of total fish consumed in Nigeria and other developing countries (Delgado, *et al.,* 2003, Mafimisebi, 2007). The rapidly growing field of aquaculture has been recognized as a possible saviour of the over-burdened wild fisheries sector and an important new source of food fish for the poor (FAO 1995, Williams, 1996).

Most parts of the maritime (coastal) region of Nigeria (about 800km coastline, FDF, 1979) are suitable for aquaculture. The coastal area is in two parts; the upland communities (which make up about 25.0% of the total land area) and the mangrove swamp areas, which are perennially inundated by flood or flooded for most parts of the year. The upland communities are characterized by fresh water while the mangrove areas have brackish water. Aquaculture first started in the upland parts of the coastal areas of Southwest, Nigeria. Today, a good number of private commercial fish farms are found there. However, owing to the relative scarcity and high cost of acquiring land in the upland areas, many prospective fish farmers have not been able to commence the business of fish farming. In comparison, only a few private commercial fish farms are found in the relatively land-surplus mangrove parts. The particularly difficult terrain of the mangrove areas especially with respect to its physiographic nature, water quality, distance from input source, problem of fish pond construction and the possibility of flooding, were cited as reasons why prospective investors shy away from locating their fish farms in the mangrove areas (Mafimisebi, 1995).

The result of this is a vast expanse of mangrove land lying unused while there is serious competition for land in the upland parts. For example, Ondo State, one of the coastal states in Southwest, Nigeria, has an estimated 850 and 2450 hectares of exploitable fresh and brackish water fishing grounds. While more than 80.0% of the fresh water fishing grounds is being exploited with about 10.0% of this under aquaculture, less than 4.0% of the brackish water grounds is being exploited with only about 1.0% under fish farming (Ondo State Agricultural Development Project, 1996). In Nigeria as a whole, the same situation holds. Fish farming is the least exploited fishery sub-sector with the vast brackish water fishing grounds almost unexploited. Less than 1.0% of the fresh water grounds and about 0.05% of the brackish water grounds are under aquaculture to produce a current average yield of 20,500 tonnes of fish per annum. This represents only 3.12% of the estimated fish culture potential of 656,815 tonnes per annum. When the current output is compared with potential yield, one will immediately appreciate the need for increased effort at bringing most, if not all land suitable for aquaculture under cultivation (Ajayi and Talabi, 1984, Tobor, 1990, Falusi, 2003). In fact, apart from increasing the land area under aquaculture, astute management system targeted at doubling the present national aquaculture production rate of 1.5tonnes/ha/yr should be employed. If this can be achieved, total potential yield will increase to 1,831,000 tonnes per year, which will exceed the projected fish demand of between 1,562,670 tonnes and 1,609,920 tonnes per annum by the year 2010 and beyond (Tobor, 1990, Dada, 1996, FOS, 2005).

The observation that investors are biased against the mangrove areas of Southwest, Nigeria in siting of their fish farms, was the motivation to compare the yield performance and profitability in the two fish farm locations of upland and mangrove. This is necessary because commercial fish farmers have two major objectives; the provision of fish for human consumption and employment opportunities, which can only be realized when maximum income and profitability are achieved in farmed fish production (Fagbenro, 1987). The specific objectives of the study are to (1) describe the operational characteristics of the fish farms (2) compute and compare indices of yield performance in the two sets of farms and (3) identify the constraints encountered by farmers in the two locations.

MATERIALS AND METHODS

Study Area and Sampling Technique

The study was carried out in Southwest, Nigeria. Multi-stage sampling technique was used in collecting the data analyzed in this study. Two out of the six states that make up Southwest, Nigeria; Ondo and Ogun States, were purposively selected on the basis of having the highest aquaculture production figures. Four (4) Local Government Areas (LGAs), two from each state, were also purposively selected for having both upland and mangrove communities with exploitable fishing grounds. The two LGAs selected from Ogun State were Ijebu Waterside and Ijebu East while Ilaje and Ese-Odo LGAs were selected from Ondo State. From a list of registered commercial fish farms got from the Agricultural Development Programme (ADP) offices in the two states, thirty (30) and fifteen (15) commercial fish farms from the upland and mangrove areas were systematically selected.

Data and Data Collection

A well-structured questionnaire was used to obtain information on characteristics and management of fish farms, fish species cultured and items of costs and returns on the production process between years 2002 and 2006. Farm records of the farms surveyed were also made available to the data collectors. The fixed costs incurred in production were calculated as annual cost or rental values of fixed items. The depreciated cost (obtained through the straight-line method) represents annual lost in value of the facilities and equipment arising from wear and tear. The expected useful life (in years) of fixed items are indicated as follows: fish pond (20), boat/canoe (10), net (5), wheel-barrow (5), bowl (5), refrigerator/pumping machine (10), weighing scale (10), outboard engine (10), farm building (25) and hatchery (10). Copies of a set of questionnaires were administered to the owners or farm managers of the farms surveyed. The questionnaire was earlier pre-tested on fish farmers in the riverine areas of Irele and Ado-Odo/ Ota LGAs of Ondo and Ogun States respectively. In all, forty-five (45) fish farmers provided the data analyzed in this study.

Analytical Techniques

The data collected were analyzed using descriptive statistics which included frequency counts, percentages and tables. The budgetary model was used to determine the level of profit generated. The budgetary analysis was first carried out for all the five years (2002-2006) pooled together and then on a year-by-year basis. From the results of the yearly budgetary analysis, certain ratios of profitability and efficiency were obtained. These are:

i) Operating Ratio (OR) TVC/ GR (1)

ii) Returns on Sales (ROS) NP/GR (2)

iii) Returns on Assets (ROA) GM/ TCA (3)

Where TVC = Total Variable Cost, GR= Gross Revenue, NP = Net Profit, GM = Gross Margin and TCA = Total Cost of Assets.

The combined cash flow and sensitivity analysis was done to ascertain the extent of profitability of the aquaculture business and the factor(s) to which profitability is responsive. The profitability indicators used to measure the extent of returns from aquaculture are:

i) Benefit-Cost Ratio (B/C): This is the ratio of discounted costs to discounted revenue. A B/C of greater than unity is desirable for a business to qualify as a good one. Mathematically, B/C is stated as:

$$B/C = \frac{\sum_{t=1}^{n} \frac{Bt}{(1+r)^n}}{\sum_{t=1}^{n} \frac{Ct}{(1+r)^n}} \quad (4)$$

where

Bt = benefit in each project year
Ct = cost in each project year
n = number of years
r = interest or discount rate

ii) Net Present Value (NPV): This is the value today of a surplus that a project makes over and above what it would make by investing at its marginal rate. Alternatively, it is defined as the value today of all streams of income which a project is to make in future. For a good business, NPV must be positive at the chosen discount factor. Mathematically, NPV is given as:

$$NPV = \sum_{t=1}^{n} \frac{Bt - Ct}{(1+r)^n} \quad (5)$$

Where Bt, Ct, n and r are as earlier defined.

iii) Internal Rate of Return (IRR): It is the rate of return that is being expected on capital tied down after allowing for recoupment of the initial capital. The IRR is the rate of interest which equates the NPV of the projected series of cash flow payments to zero. It is also called the yield of an investment. Mathematically, it is given as:

$$IRR = \sum_{t=1}^{n} \frac{Bt - Ct}{(1+r)^n} = 0 \quad (6)$$

Practically, the IRR is usually obtained through a series of manipulations where two discount factors give rise to two NPVs. The NPV must be positive at the lower discount factor and negative at the higher discount factor indicating that the project can earn higher than the lower discount factor and lower than the higher discount factor. In this trial and error method, according to Adegeye and Dittoh (1985), the IRR is given as:

$$IRR = \underset{\text{lower discount}}{rate} + \underset{\text{difference between the two}}{\text{discount rates}} \left(\frac{NPV \text{ at lower discount rate}}{\text{absolute difference between the two NPVs}} \right) \quad (7)$$

RESULTS AND DISCUSSION

Operational and Farm Characteristics

The total farm size (area covered by fish ponds) of the 30 upland farms was 332,558m^2 while the total number of pond units was 168. Therefore, the average size of an upland fishpond was 1978m^2. The total size of the 15 mangrove farms was 1,226,575m^2 and the number of fishpond units was 154 giving an average size of 7,965m^2. Thus, fishponds have bigger sizes in the mangrove areas. The two possible reasons for this finding are that land is relatively cheaper in the mangrove areas and also that most mangrove farmers use the polyculture method while majority of upland farmers, use the monoculture method. About 96.0% and 68.2% of upland and mangrove farmers respectively, were engaged in purely table fish production while the balance in each case combined table fish with fingerlings/post-fingerlings (jumpers) production. The higher proportion of mangrove farmers combining both table fish and fish seeds production compared with the upland farms is probably owing to the presence of larger water bodies from which seeds of spawning fish can be harvested and further reared to jumpers before being used to stock ponds. This is a saving on cost of inputs but has a negative effect on capture fisheries since the fingerlings are the ones expected to grow into table fish in the natural water bodies (Touminen and Esmark, 2003).

Majority (60.0%) of the farmers procures their fish seeds from the wild (Table 1). According to the farmers interviewed, the natural source of fish seeds is cheaper and more readily available. The farmers in the upland parts contract out fish seeds procurement to people to whom they give part payment to facilitate timely delivery. Alternatively, fish farms sometimes assign that duty to some of their workers if they have enough workforce. In comparison, some workers of mangrove farms have fish seeds procurement as their major responsibility. They harvest fish seeds of various fish during the spawning seasons. Such harvested seed stocks are furthered reared in a special pond. During this period, stunted, deformed and unhealthy seed stocks are removed and the remaining used for stocking fish ponds. A higher proportion of mangrove farmers got their fish seeds from the wild. Procuring fish seeds from the wild by most mangrove farmers and some upland farmers, is an economic response to the problem of acute shortage of high quality fingerlings from government or private hatchery which is capable of crippling production. They claimed that where fish seeds produced in modern hatcheries are available, the cost is prohibitive more so because of the transportation cost incurred. Thus, despite the fact that farmers using fish seeds from the wild are aware of the negative impact of their action on yield from capture fisheries, they asserted that they will continue to use this source until there is an alternative arrangement that is acceptable to them. There had also been frequent bloody clashes between fish seeds harvesters and capture fisheries fisher folks in the study area. This means that an urgent alternative has to be found to procuring fish seeds from the wild if the problem of threatened stocks of wild fish reported by FAO (1995, 1998 and 2000) is not to be further compounded in Nigeria.

From Table 1, it is obvious that about 88.9% of farmers depend on the wild for their fish seeds. Only about 6.7% and 4.4% of farmers procure their fish seeds from own modern hatchery and government-owned hatchery. There is a need to re-orientate farmers away from using fish seeds from the wild to stock their fishponds. Most of the farmers which depend on the wild indicated that they would have preferred seed stocks from specialized private or public hatcheries because of their high quality if the prices can be reduced and if some hatcheries can be sited close to them.

Fish Species Cultured

The species commonly reared in the upland farms were Tilapia, Alestes, Heterotis and Catfish and these fish species were raised by over 70.0% of the farmers. The other fish species which are reared but not as frequently as the above species are Mudfish, Heterobranchus, Ophiocephalus, Aeroplane fish and Mormyrus. These species were reared by less than 25.0% of the sample farms. The reasons given for preference for the most popularly cultured species include (1) ease of procurement and high rates of survival of the seeds (2) easy culturing (3) fast growth and reproductive rates when supplementary feeding is practised (4) high yield and (5) high demand and price in the study area. In the mangrove farms, however, the commonest fish species reared in order of frequency are Alestes (78.13%), Tilapia (60.75%), Gymnarchus (56.25%) and Heterotis (46.88%). Other fish species were Catfish, Aeroplane fish and Ophiocephalus. Only about 30.0% of the sample mangrove farms had these fish species reared in them.

Cost Component Analysis for Fish Farms

In both farm situations, the single most expensive item of variable cost was fish feeds. It accounted for 51.43% of variable cost in upland farms and 57.79% in the mangrove farms. This difference is probably owing to the astuteness of the upland farmers who formed small groups of 5-10 and pooled their money together to buy fish feeds directly from feed milling companies whereas most mangrove farmers bought their feeds from the dealers in the headquarters of their LGAs. Travelling long distances to the headquarters of their LGAs to buy small quantities of feeds, each time they run out of stock, leads to increased transportation cost. Added together, seed stocks and fish feeds accounted for 68.73% and 69.67% of variable cost in the upland and mangrove farms respectively. This high proportion

Table 1: Distribution of Farmers by Source of Fish Seeds

Source of Fingerlings	Frequency	Percentage
From wild	27	60.00
From own modern hatchery	03	6.67
From other farmers rearing	13	28.89
wild fish seeds	02	4.44
From government hatchery	45	100.00
Total		

Source: Survey data, 2007

Table 2: Fixed and Variable Cost for One-Hectare Upland and Mangrove Fish Farms

Fixed Items	Upland Farms		Mangrove Farms	
	($)%	Composition	($)%	Composition
Land	335.54	4.10	120.36	1.10
Pond construction	872.41	10.67	875.57	8.08
Farm buildings	374.58	4.58	202.85	1.86
Vehicles + boats	979.64	11.98	1,761.66	16.18
Nets	183.54	2.25	624.54	5.74
Boreholes + Water pumps	1,814.98	22.53	1,103.20	10.13
Wheel Barrow + Basins	96.64	1.18	116.65	1.07
Generators/Deep freezers/ Weighing Scale	35.98	0.04	344.37	3.16
Local hatchery + Fencing materials	35.10	0.43	483.12	4.44
Labour (permanent)	3,419.83	41.83	5,252.95	48.24
Sub-total	**8,175.23**	**100.00**	**10,890.00**	**100.00**
Variable Items				
Fingerlings & Jumpers	5,721.47	17.30	3,549.06	11.88
Fish feeds	17,012.70	51.43	17,264.76	57.79
Fertilizer + Other Chemicals	8,740.02	2.64	1,614.42	5.40
Transportation + Fuelling	4,352.90	13.16	3,797.43	12.71
Repairs + Maintenance	3,034.72	9.18	2,479.21	8.30
Casual labour	2,081.96	6.29	1,171.51	3.92
Sub-total	**33,078.49**	**100.00**	**29,876.39**	**100.00**

Source: Survey data, 2007.
Note: For the period covered by the data used for this study, the average exchange rate was N127= $1 while the value fluctuated between N125 and N129.

accounted for by seed stocks and fish feeds as items of variable expenses is in accordance with the findings by Zadek (1984), Inoni, (1992) and Mafimisebi, (2003) that cost of feeds and seed stocks accounted for more than 50.0% of total production cost in aquaculture (Table 2).

The depreciated average fixed cost, per hectare of upland fish farm was $8,175.23 in the five years covered by the study. The corresponding value for the mangrove farm was $10,890.00. The depreciated cost of pond construction and vehicle/boats carried 10.67% and 11.98% respectively in the upland farms while the same items accounted for 8.08% and 16.18% respectively in the mangrove farms. The cost of pond construction was higher in the mangrove farms because the mangrove species have had to be cleared first before pond construction proper begins. Not only that, the problem of pond edge stabilization gulps a lot of money compared with upland ponds. This is more so because fish pond construction in the mangrove areas involves putting special structures in place to prevent escape of fish into the wild during slight or excessive flood. Table 2 also shows that land is cheaper in the mangrove areas. However, the cheap cost of land as an item of fixed cost is eroded by the heavy expense on pond construction in the mangrove parts.

For the two farms, labour was the single most expensive item of fixed cost. While labour accounted for 41.83% of fixed cost in the upland farms, the value for the mangrove farms was 48.24%. Also revealed in Table 2 is the fact that seed stocks constituted about 17.00% of variable cost in the upland farms while the corresponding value in the mangrove farms was 12.00%. This is attributable to the fact that more upland farmers than mangrove farmers procured seed stocks from sophisticated private and public hatcheries. The seed stocks bought from such hatcheries were more expensive than the ones bought from local hatcheries.

Gross Revenue

Gross Revenue (GR) is the amount realized from sale of table fish, fingerlings and jumpers. However, because revenue from sales of fingerlings and jumpers is negligible, only revenue from table fish production is considered in this study. The information on GR from the various fish species cultured is provided in tables 3 and 4.

While the upland farms made net revenue of $87,171.39 per hectare for the period studied, the mangrove farms got $81,446.06 per hectare for the same period. Therefore the average net profit per hectare per year was $9,183.53 and $8,135.93 in the upland and mangrove farms respectively. Table 3 shows that in the upland parts, Heterotis contributed the highest proportion of GR followed by Gymnarchus and Alestes while Ophiocephalus, Heterobranchus and Mormyrus together amounted to just about one-fifth of GR. It can thus be concluded that Heterotis, Gymnarchus and Alestes were the major commercial species cultured in the upland areas. Table 4 showed that Alestes accounted for the highest proportion of GR followed by Heterotis, Gymnarchus and Tilapia, in that order in the mangrove farms. Catfish, Ophiocephalus and Aeroplane fish contributed less than one-fifth of GR. The major commercial species in the mangrove parts were Alestes, Heterotis, Gymnarchus and Tilapia

For both farms, there was positive net revenue indicating that aquaculture is operating at a profit in the two locations. This finding of positive net revenue in the mangrove farms contradicts earlier findings by Inoni (1993), Falusi (2005) and Zadek (1984) that mangrove farms in Delta and Ogun States, Nigeria and Port Said, Egypt respectively, sustained losses during an operational period of between 1987 and 2003.

Profitability and Efficiency Ratios

The year-by-year results of the budgetary analysis are shown in Table 5. From the values given in the table, profitability ratios that enabled us to arrive at a conclusion as to the efficiency of operation of the two fish farms, were calculated.

The data presented in Table 6 showed the profitability ratios by year of the two sets of farms. A decrease in OR over time is an indication of a good and efficient business. A decline in OR in the study indicates either increasing TR

Table 3: Gross Revenue on a One-Hectare Upland Farm

Fixed Items	Gross Revenue per year ($)					
	2002	2003	2004	2005	2006	Total 2002-2006
Heterotis	4,336.18	4,711.20	4,701.75	5,475.05	6,544.36	25,768.54
Gymnarchus	3,869.69	3,710.66	4,152.84	4,475.54	5,565.61	21,774.34
Alestes	2,543.66	1,687.22	3,150.56	3,799.76	4,302.56	15,483.76
Tilapia	1,146.18	1,100.48	1,425.83	1,297.55	1,333.61	6,309.38
Catfish	905.79	1,020.44	1,267.51	1,529.09	1,705.11	6,427.94
Heterobranchus	735.33	821.90	1,170.59	1,261.75	1,604.48	5,594.05
Mudfish	248.05	185.26	321.26	401.57	354.33	1,510.47
Ophicephalus	659.29	584.21	818.12	924.16	1,314.05	4,299.83
Mormyrus	0.44	0.32	0.57	0.69	1.06	3.07
Total	**14,444.61**	**13,821.70**	**17,014.75**	**19,165.17**	**22,725.17**	**87,171.39**

Source: Survey data, 2007.

Table 4: Gross Revenue on a One-Hectare Mangrove Farm

Fixed Items	Gross Revenue per year ($)					
	2002	2003	2004	2005	2006	Total 2002-2006
Heterotis	3,032.48	2,869.13	3,618.94	3,834.44	4,466.87	17,821.87
Gymnarchus	2818.32	2,583.13	3,276.63	3,784.87	3,961.48	16,424.43
Alestes	3,830.15	3,520.86	4,125.83	4,821.94	5,624.02	21,922.80
Tilapia	1,926.61	1,637.28	2,191.20	2,792.60	3,065.33	11,613.02
Catfish	1,529.54	1,338.63	1,710.50	1,993.95	2,487.39	9,060.16
Ophiocephalus	733.53	618.66	867.52	1,009.74	1,321.36	4,550.81
Aeroplane fish	6.90	6.02	9.63	14.01	16.56	53.11
Total	**13,877.53**	**12,573.72**	**15,800.24**	**18,251.54**	**20,943.02**	**81,446.06**

Source: Survey data, 2007.

Table 5: Year by Year Budgetary Analysis of a One-Hectare Farm

	Total Variable Cost ($)		Gross Revenue ($)		Gross Margin ($)		Net Profit ($)	
Year	Upland	Mangrove	Upland	Mangrove	Upland	Mangrove	Upland	Mangrove
2002	6,456.50	5,795.91	14,365.83	13,877.53	7,988.07	8,081.17	7,608.72	6,931.37
2003	5,481.22	5,090.61	13,821.70	12,573.72	8,340.48	7,483.11	7,280.60	6,280.16
2004	5,244.86	4,612.34	17,014.75	15,800.24	11,769.89	11,187.90	8,962.55	7,891.71
2005	7,272.51	6,695.12	19,165.17	18,251.54	11,892.66	11,556.44	10,095.28	9,116.05
2006	8,623.40	7,682.41	22,725.16	20,943.02	14,101.76	13,260.62	11,970.52	10,460.36

Source: Survey data.

Table 6: Profitability and Efficiency Ratios for a One-Hectare Farm

Operating ratios			Return on sales		Return on sales	
Year	Upland	Mangrove	Upland	Mangrove	Upland	Mangrove
2002	0.447	0.418	0.527	0.499	1.680	1.434
2003	0.397	0.405	0.527	0.499	1.754	1.327
2004	0.308	0.292	0.527	0.499	2.475	1.985
2005	0.379	0.367	0.527	0.499	2.501	2.050
2006	0.379	0.367	0.527	0.499	2.965	2.352
Average	**0.382**	**0.370**	**0.527**	**0.499**	**2.275**	**1.830**

Source: Survey data.

or decreasing TVC. For the upland farms, OR was 0.447 in 2002 which decreased to 0.397 and 0.308 in 2003 and 2004. The value took an upward turn to 0.379 which was maintained in 2006. The same pattern was observed in the mangrove farms. OR fell from 0.418 in 2002 to 0.405 and 0.292 in 2003 and 2004 respectively but picked up to 0.367 in 2005 which remained same in 2006. For the period studied, average OR was 0.382 in the upland farms and 0.370 in the mangrove farms. Judging by these ratios, the mangrove farms seemed to promise a better efficiency in future years as OR was falling faster than in the upland farms. The increase in OR in years 2005 and 2006 on both farms is clearly not a desirable situation. The farmers must do all that is possible to achieve a consistently decreasing OR. This can be achieved by a more efficient use of farm resources. For example, feeding fish beyond a stipulated market weight should be avoided as the rate of growth slows down compared with the quantity of feeds consumed. Also, farmers should explore avenues for wider market outlets so that mature fish can be promptly disposed off. This scenario will lead either to a decreasing TVC or an increase in TR which will depress OR.

An increasing return on sales over time indicates a stable, profitable and efficient business. Return on sales was constant in the period studied on both farms. It was 0.527 for the upland farms and 0.499 for the mangrove farms. Fish farmers in both farm locations need to take steps to ensure an increasing return on sales.

The indication that assets are being more increasingly utilized is increasing returns on assets. On the upland farms, there was an increasing trend of returns to assets from 2002 to 2005 but there was a fall in the value in 2006. On the mangrove farms, the trend in returns on assets was towards an increase except in years 2003 and 2006 in which the figures fell below the year preceding them.

Combined Cash Flow and Sensitivity Analysis

Some assumptions were necessary in carrying out this analysis. These assumptions are as follows:

(1) The average bank lending rate to agriculture in the thirteen (13) years covered by the analysis is 25.0%.

(2) A risk-discounted factor of 5.0% is added to the bank lending rate meaning that a discount factor (DF) of 30% is used.

(3) There is a 20.0% and 10.0% projected annual increase in variable cost and unit price of fish between 2006 and 2014. This is in accordance with the farm management maxim which says it is better to be optimistic about cost rise and pessimistic about revenue increase in the estimation of future profitability of a business (Adesimi, 1985).

The result of the combined cash flow and sensitivity analysis for the upland and mangrove farms are shown in Tables 7 and 8 respectively. The results indicate that aquaculture is profitable at both locations at the assumed bank lending rate in spite of prices of key production inputs rising faster than output price. For the upland farms, the NPV stood at $10,887.24, the B/C was 1.28 and IRR was 48.55%. The corresponding values for the mangrove farms were $10,375.84, 1.29 and 48.51%. Thus, the results are comparable and do not show any considerable difference in yield performance between the two types of farms. While at the assumed bank lending rate, the upland farms would return $0.19 for every $0.79 invested, the farms located in the mangrove areas will also return approximately $0.19.

Constraints to Upland and Mangrove Fish Farming

Fish farmers in the two farm locations were asked to rank the constraints identified in their business. The problems encountered by the mangrove farmers in rank order were (1) financial constraints; (2) high and rising cost of feeds; (3) flooding which leads to total loss of investment whenever it happens as fish escape into the wild. Numerous studies have named potentially negative effects of escaped farmed fish on wild populations (Naylor *et al.,* 2000); (4) silting up of ponds which result in massive death of cultured fish; (5) pests which include snakes, water-dogs and piscivorous birds; (6) attack by capture fishermen during sourcing of fish seeds from wild; (7) water pollution and (8) inadequate access to extension services. Only about 30% of mangrove farmers had had a contact with extension agents since commencement of business.

The problems commonly encountered by farmers in the upland areas were (1) financial constraints occasioned by high running costs; (2) drying up of ponds owing to seepage of water through dykes; (3) massive loss of fish owing to polluted or high-temperature water; (4) scarcity of high quality seed stocks and (5) problems of

Table 7: Cash Flow and Sensitivity Analysis for a One-Hectare Upland Farm (2002-2014)

Year	Cost ($)	Revenue ($)	Incremental Benefit ($)	DF 30%	NPV 30% ($)	DF 50%	NPV 50% ($)	Discounted Cost ($)	Discounted Revenue ($)
2001	21,774.18	-	-21,774.18	0.769	-16,744.35	0.667	-14,523.38	16,744.35	-
2002	6,456.50	14,444.57	7,988.07	0.592	4,728.94	0.444	3,546.71	3,822.25	8,551.19
2003	5,481.22	13,821.70	8,340.48	0.445	3,711.51	0.296	2,468.78	2,439.14	6,150.66
2004	5,244.86	17,014.74	11,769.89	0.350	4,119.46	0.198	2,330.44	1,835.70	5,955.16
2005	7,272.51	19,165.17	11,892.66	0.269	3,199.13	0.132	1,569.83	1,956.30	5,155.43
2006	8,623.40	22,725.17	14,101.76	0.207	2,919.06	0.088	1,240.96	1,785.04	4,704.11
2007	10,348.08	24,997.45	14,649.37	0.159	2,329.25	0.059	864.31	1,645.35	3,974.59
2008	12,417.70	27,497.19	15,079.49	0.123	1,854.78	0.039	588.10	1,527.38	3,382.15
2009	14,901.24	30,246.91	15,345.67	0.094	1,442.49	0.026	398.99	1,400.72	2,843.21
2010	17,881.49	33,271.60	15,390.12	0.073	1,123.48	0.017	261.63	1,305.51	2,428.83
2011	2,142.82	36,598.76	15,140.98	0.056	847.89	0.012	181.69	1,201.64	2,049.53
2012	2,576.11	40,258.64	14,509.30	0.043	623.90	0.008	116.07	1,107.22	1,731.12
2013	30,899.21	44,284.50	13,385.29	0.033	441.71	0.005	66.93	1,019.67	1,461.39
2014	37,079.47	48,712.95	11,633.90	0.025	290.85	0.003	34.90	926.98	1,217.84
					10,888.11		**-854.04**	**38,717.24**	**29,031.78**

Source: Field data and projected figures

Notes: (1) 2001 is the investment year (year zero), so there is no revenue

(2) Costs and Revenues for 2002-2006 are actual flows recorded by the fish farms

(3) Cost and revenues for 2007 – 2014 are projected figures

NPV at 30% = 10,888.11 IRR = 48.55% B/C = 1.28

Table 8: Cash Flow and Sensitivity Analysis for a One-Hectare Mangrove Farm (2002-2014)

Year	Cost ($)	Revenue ($)	Incremental Benefit ($)	DF 30%	NPV 30% ($)	DF 50%	NPV 50% ($)	Discounted Cost ($)	Discounted Revenue ($)
2001	20,898.93	-	-20,898.93	0.769	-16,071.28	0.667	-9,215.18	16,071.28	-
2002	5,795.91	13,877.53	8,081.62	0.592	4,784.32	0.444	3,588.24	3,431.18	8,215.50
2003	5,090.61	12,573.72	7,483.11	0.445	3,329.98	0.296	2,215.00	2,265.32	5,595.30
2004	4,612.34	15,800.24	11,187.90	0.350	3,915.77	0.198	2,215.20	1,614.32	5,530.09
2005	6,695.12	18,251.54	11,556.44	0.269	3,108.68	0.132	1,525.45	1,800.98	4,909.67
2006	7,682.41	20,943.02	13,260.62	0.207	2,744.95	0.088	1,166.93	1,661.12	4,335.21
2007	9,218.73	23,037.33	13,818.44	0.159	2,197.13	0.059	815.29	1,465.80	3,662.93
2008	11,062.67	25,341.06	14,278.39	0.123	1,756.24	0.039	556.82	1,360.71	3,116.95
2009	13,275.20	27,875.16	14,599.96	0.094	1,372.40	0.026	379.60	1,247.87	2620.27
2010	15,930.24	30,662.68	14,732.44	0.073	1,075.47	0.017	250.45	1,162.91	2,238.39
2011	19,116.29	30,662.68	14,612.66	0.056	818.31	0.012	175.35	1,070.51	1,888.82
2012	22,939.55	33,728.95	14,162.30	0.043	608.98	0.008	113.30	986.40	1,595.38
2013	27,527.46	37,101.84	13,284.57	0.033	438.39	0.005	66.42	908.41	1,346.80
2014	33,032.95	40,812.13	11,860.28	0.025	296.51	0.003	35.58	825.82	1,122.33
					10,375.84		**-835.92**	**35,801.77**	**46,177.60**

Source: Field data and projected figures
Note: NPV at 30% =10,375.84 IRR = 48.51% B/C = 1.29

theft which can lead to over-night harvesting of fish ponds with marketable fish if security is not beefed up around ponds. These are the problems that must have solutions proffered to them for the operation of these farmers to be enhanced.

CONCLUSION AND RECOMMENDATIONS

The study explored the operational characteristics of upland and mangrove farms, compared costs and profitability of investment in the two locations and determined the production variables to which profitability is more sensitive. The study also examined the constraints to fish farming in the two locations.

Empirical results show that mangrove farms are about four times bigger in size than the upland farms. Monoculture method was prevalent among mangrove farmers while the upland farmers mostly practised polyculture. The commercial species reared in the study area were Tilapia, Alestes, Heterotis and Gymnarchus while Ophiocephalus, Catfish, Heterobranchus and Mormyrus were the minor commercial species. The depreciated fixed cost in the upland farms was lower than that of the mangrove farms. However, the level of variable cost in the upland farms was greater than that of the mangrove farms. In both farms, the cost of labour was the single most expensive item of variable cost. G.R per hectare was comparable in the two farm situations but slightly higher in the upland farms. Profitability ratios which indicate efficiency did not show any considerable difference in the yield of investment from the two farm locations. The result from the combined cash flow and sensitivity analysis shows that investment in aquaculture is profitable at both farm locations. All performance indicators show that profitability is not different between farms in the two locations to justify the avid preference for the upland locations in the siting of fish farms in the coastal areas of Southwest, Nigeria.

The magnitude of cost involved in establishing and managing a fish farm is clearly beyond that affordable by a peasant farmer. Investible funds in form of loans should be made available to prospective investors wishing to site their farms in the mangrove areas at affordable interest rate. The study has shown that fish farmers can repay loans advanced to them conveniently if given a moratorium of two years.

There is also the need to encourage investors in hatcheries to produce fish seeds for use by fish farmers especially in the mangrove areas where majority of the farmers depend on the wild for their fish seeds. Once the government has succeeded in attracting investors in hatcheries to the mangrove areas, a campaign against the use of fish seeds from the wild in the study area should be launched. As soon as the hatcheries can produce enough seed stocks to satisfy all identified fish farmers, the practice of procuring fish seeds from the wild should be banned. This is a matter of priority if yield from aquaculture is to be increased and natural fisheries resources conserved. Finally, since the level of capital investment for establishing fish farms is very high, the government can subsidize cost of fish feeds for new investors in the mangrove areas only in the first year of operation. This may serve to attract investors into the area so that the vast mangrove land can be put to productive use. There is also the need to step-up extension visits to fish farmers.

It is also recommended that farmers in the mangrove areas take policy with the Nigerian Agricultural Insurance Company so that they can be indemnified if there is loss of investment from fish escapes during periods of excessive flood.

All performance indicators show that profitability is not different between farms in the two locations to justify the bias against the mangrove areas in the siting of fish farms in the coastal areas of Southwest, Nigeria. Solving some of the identified problems of fish farmers in both locations is a step towards cheap and affordable animal protein production especially in the vast mangrove areas with its hydrographic characteristics.

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Effectiveness of Extension Services in Enhancing Outgrowers' Credit System: A Case of Smallholder Sugarcane Farmers in Kisumu County, Kenya

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Abstract

The purpose of this study was to investigate the role of extension services in enhancing effectiveness of outgrowers' credit system in Kisumu County, Kenya. The study specifically sought to determine whether public and private extension services play a significant role in enhancing effectiveness of out-growers' credit system among smallholder sugarcane farmers. A total of 110 small scale farmers were randomly selected for the study. A closed ended questionnaire was used to collect data from farmers. Both descriptive and inferential statistics were used for data analysis. The findings indicated that both public and private extension services were insignificant in enhancing effectiveness of outgrowers' credit system. Further, the findings indicated that there was no significant difference between public and private sector in provision of extension services. The findings suggest that for outgrowers' credit system to be effective in terms of creation of awareness about credit, accessibility, timely supply of credit, supervision of credit and provision of extension advice on credit utilization, both public and private extension services should be intensified and coordinated to avoid duplication. The results also suggest that sugarcane factory extension division should be strengthened just like in the coffee and tea sub-sectors.

Keywords:
Public extension service, Private extension service, Outgrowers' Credit system, Effectiveness, Western Kenya

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INTRODUCTION

The importance of agriculture to the African economies is stressed due to the fact that agriculture remains the principal occupation of the majority of people, constitutes the largest production sector, and produces an average of 32% of GDP, major sources of raw materials for industries and a significant purchaser of the countries manufacturers and services (Agbamu, 2005). In Kenya for example, the economy is heavily dependent upon agricultural sector and as the World Bank (2007) report indicates, the country's future will considerably depend on productivity of smallholder farms. Agriculture is by far the single largest economic sector in Kenya and accounts for about 30% of GDP, over 60% of the exports, 75% of the total labour force and provides 80% of industrial raw materials (Economic Survey, 2007; Kenya Sugar Research Foundation, 2007, Government of Kenya, 2005). Since independence, smallholder agriculture gained ground from mere provision of subsistence and minimal marketed surplus to account for over three quarters of agricultural production and 85% of agricultural employment (GoK, 2005, World Bank, 2007). Sugarcane farming is one such subsector that contributes to the national economy. According to Guda *et al.,* (2001) smallholder farmers accounts for 89% of the total area under sugarcane farming in Kenya. This provides an investment opportunity. However, this is only possible if the problems affecting it are addressed. Some of the main problems include shortage of sugarcane due to lack of systemic and synchronised sugarcane development, poor crop husbandry practices, poor cane varieties and qualities in some factory zones, poor harvesting methods, poor management in some factories affecting factory efficiency and output and inadequate agricultural production credit among others (Guda *et al.,* 2001). However the most notable problem is complaints due to delayed payment dues to the farmers after cane delivery. These problems have elicited diverse reactions from the farmers. The most severe reactions are cases of burning the cane crop by the farmers in their own farms, so as to turn to other lucrative enterprises like maize or bean seed production (Agribusiness Development Support Project Annual Report, 2001).

Agricultural extension is considered to be an important service in increasing agricultural productivity and attaining sustainable development (Kibet, *et al.,* 2005). Its role is to help people identify and address their needs and problems. There is a general consensus that extension services if successfully applied, should result in outcomes which include observable changes in attitudes and adoption of new technologies, and improved quality of life based on indicators such as health, education and housing. It has been recognized that agricultural extension accelerates development in the presence of other factors such as markets, agricultural technology, availability of supplies, production incentives and transport (Kibet, *et al.,* 2005). Koyenican (2008) equates help in extension to empowering all members of the farm households to ensure holistic development. This is because agricultural extension brings about changes, through education and communication in farmers attitude, knowledge and skills.

The performance of the public agricultural extension service in Kenya has been a very controversial subject (Gautam and Anderson, 1999). The system has been perceived as top-down, uniform (one-size-fits-all) and inflexible and considered a major contributor of the poor performing agricultural sector (Government of Kenya, 2005). Thus there has been a desire to reform extension in to a system that is cost effective, responsive to farmer's needs, broad based in service delivery, participatory, accountable and sustainable. As a result of ineptness in the public extension system, private agricultural extension system has emerged comprising of private companies, non-governmental organizations (NGO's), community based organizations (CBO's) and faith based organizations (Nambiro *et al.,* 2005 and Rees *et al.,* 2000).

Agricultural extension as a public sector institution has an obligation to serve the needs of all agricultural producers, either directly or indirectly (Anderson, 2007). This is because public sector extension is a public good. The Kenya government has tried a number of extension models and styles, including the progressive (farmer approach) model, integrated agricultural rural development approach, farm management, training and visit, farming systems approaches and farmer field schools. All these approaches have emerged with varying level of success for different groups. However, the effectiveness of extension services in enhancing effectiveness of outgrowers' credit system among sugarcane farmers in Kisumu County of Kenya has not been examined. Thus the present study was set with the premise that both outgrowers' credit and extension service are instruments for promoting agricultural development and that an efficient and effective extension service is important in enhancing effectiveness of outgrowers credit system. Credit to farmers is an important instrument in improving productivity. Indeed as Wangia (2001) noted, it is a prerequisite to the adoption of improved agricultural technologies for the smallholder farmers. Nevertheless, for credit system to help the smallholder farmers it should be tied to improved technologies, remunerative prices for the farmers' output and good extension network (Ogunsumi, 2004).This paper presents results on the role of extension services in enhancing effectiveness of outgrowers' credit system among smallholder cane farmers in Kenya.

Conceptual Framework

This study formulated a conceptual model that encompassed major variables and their possible patterns of influence on each other and eventually on effectiveness of outgrowers' credit system. The effect of the extension services namely public and private services are mediated by level of education, farm size and farmers period of residence. What this structural model indicates therefore is that the moderator variables influence adoption of sugarcane technologies disseminated by extension agents whether from public or private sector. In view of this model, the theory underpinning this study is that, adoption is complex and multifaceted process. While the main activity of extension centers on increasing production, this study concentrated on implementation of such activities. These are; creation of awareness about credit, accessibility to credit, timely supply of credit, supervision of credit and provision of extension advice on credit utilization (Table 1).

MATERIALS AND METHODES

Ex-post facto survey design was adopted for this study. Kisumu county in Kenya was purposely selected because of its uniqueness in that the county boasts of three major sugar factories.

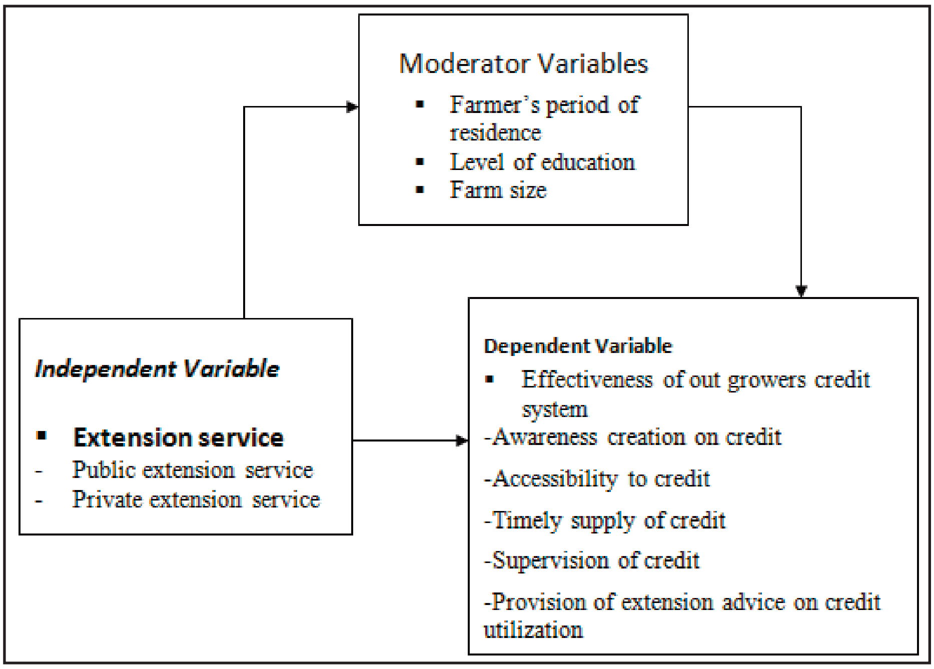

Figure 1: The Conceptual Framework on the Role of Extension in Enhancing Effectiveness of Outgrowers' Credit System

Table 1: Creation of Awareness on credit facility

Activity		SD	D	U	A	SA	Total
Creation of Awareness	f (n=23)	2.0	17.0	-	2.0	2.0	23.0
	%	8.7	73.9	-	8.7	8.7	100.0

Key (SD= Strongly Disagree, D= Disagree, U= Undecided, A= Agree, SA= Strongly Agree)

Table 2: Land Preparation

Activity		SD	D	U	A	SA	Total
Land Preparation	f (n=23)	2.0	14.0	-	6.0	1.0	23.0
	%	8.7	60.2	-	26.0	4.3	100.0

Key (SD=Strongly Disagree, D=Disagree, U=Undecided, A=Agree, SA= Strongly Agree)

These are; Miwani, Muhoroni and Chemelil which were established in the years 1923, 1966 and 1968 respectively. The County has favourable moderate climatic conditions, with temperatures averaging 27^{o} C and receives bimodal rainfall ranging from (560 -1630) mm per annum. Kisumu County comprises of the main topographical land formations namely, the Nandi hills, the Nyando plateau and Kano plains which are sandwiched between two hills. The Kano plains comprise predominantly black cotton clay soils derived from igneous rocks. The County's altitude range from 1000-1860 M above sea level. The target population was the sugarcane farmers in Kisumu county. A total of 110 smallholder cane farmers were randomly selected for the study but only 108 farmers questionnaire were useful for analysis. A closed ended questionnaire was used to collect data by personal interviews. The information gathered was analysed using both descriptive and inferential statistics.

RESULTS AND DISCUSSIONS

Public extension Services

Tables 1, 2 and 3 below shows data on different extension activities done by public sector extension service for cane farmers. Table 1 show result on the effect of public extension services in relation to creation of awareness. Creation of awareness was one of the activities used to measure public extension services. To elicit information on creation of awareness, the farmers were asked to respond to statement designed to elicit negative responses on performance resulting to creation of awareness. A 5-point likert scale was constructed to record these responses. Table 1 show results on public extension services in

Table 3: Appropriate Input Use

Activity		SD	D	U	A	SA	Total
Appropriate Input Use	f (n=23)	2.0	7.0	6	6.0	2.0	23.0
	%	8.7	30.4	26.0	26.0	8.7	100.0

Key (SD=Strongly Disagree, D=Disagree, U=Undecided, A=Agree, SA=Strongly Agree)

Table 4: Creation of awareness on credit facility

Activity		SD	D	U	A	SA	Total
Creation of Awareness	f	16.0	51.0	-	9.0	4.0	80.0
	%	20.0	63.8	-	11.3	5.0	100.0

Key (SD=Strongly Disagree, D=Disagree, U=Undecided, A=Agree, SA=Strongly Agree)

Table 5: Land Preparation

Activity		SD	D	U	A	SA	Total
Land Preparation	f (n=80)	9.0	12.0	1.0	35.0	23.0	80.0
	%	11.25	15.0	1.25	43.8	28.8	100.0

Key (SD=Strongly Disagree, D=Disagree, U=Undecided, A=Agree, SA=Strongly Agree)

Table 6: Use of Appropriate Inputs

Activity		SD	D	U	A	SA	Total
Timely Use of Appropriate Inputs	f (n=80)	3.0	17.0	-	44.0	16.0	80.0
	%	3.75	21.3	-	55.0	20.3	100.0

Key (SD=Strongly Disagree, D=Disagree, U=Undecided, A=Agree, SA=Strongly Agree)

relation to creation of awareness.

The results in Table 1 indicated that majority of farmers (82.6%) receive information on credit facility from public extension providers.

Advice on land preparation was one of the activities used to measure public extension services. To elicit information on land preparation, the farmers were asked to respond to statement designed to elicit positive knowledge of performance resulting to land preparation. A 5-point likert scale was constructed to record these responses. Table 2 show results on public extension services in relation to land preparation.

The result in table 2 showed that land preparation as an activity has not been satisfactorily addressed by public service extension officers as reflected by the high percentage (68.9%) of farmers who disagreed with the positive statement. This suggests that perhaps the declining cane production in Kisumu County is due to poor and inadequate land preparation, culminating from inadequate machinery to prepare land for cane growing.

Advice on appropriate use of inputs was one of the activities used to measure public extension services. To elicit information on the use of appropriate input, the farmers were asked to respond to statement designed to elicit positive knowledge of performance resulting to use of appropriate input. A 5-point likert scale was constructed to record these responses. Table 3 show results on public extension services in relation to appropriate use of input.

The results in table 3 showed that 39.1% of the farmers have not received services on appropriate use input from public sector extension services. This suggests that farmers do not know whether the inputs they use are appropriate or not.

Private extension service

Private sector extension may play a predominant extension role for particular inputs, particular enterprises / commodities and for particular farmer's in particular geographical areas. This enables farmers to benefit from increased incomes and economic security. Tables 4, 5, and 6 shows data on different extension activities done by private sector extension service for cane farmers.

Table 4 show result on the effect of private extension services in relation to creation of awareness. Creation of awareness was one of the activities used to measure private extension services. To elicit information on creation of awareness, the farmers were asked to respond to statement designed to elicit negative knowledge of performance resulting to creation of awareness. A 5-point likert scale was constructed to record these responses. Table 4 show results on private extension services in relation to creation of awareness.

The results in table 4 showed that majority of farmers (83.75%) received information on credit facility.

Advice on land preparation was one of the activities used to measure private extension services. To elicit information on land preparation, the

Table 7: Comparison between role of public and private extension services in Kisumu County

		Public Extension Service (N=23)				Private Extension Service (N=80)			
		LP	UAI	CA	Average	LP	UAI	CA	Average
SA	f	1.0	2.0	2.0	2.0	23.0	16.0	4.0	13.2
	%	4.3	8.7	8.7	8.7	28.8	20.3	5.0	16.5
A	f	6.0	6.0	2.0	5.0	35.0	44.0	9.0	28.2
	%	26.0	26.0	8.7	21.5	43.8	55.0	11.3	35.3
U	f	-	6.0	-	2.0	1.0	-	-	00.8
	%	-	26.0	-	8.7	1.25	-	-	01.0
D	f	14.0	7.0	17.0	12.5	12.0	17.0	51.0	27.4
	%	60.2	30.4	73.9	53.8	15.0	21.3	63.8	34.3
SD	f	2.0	2.0	2.0	1.8	9.0	3.0	16.0	10.4
	%	8.7	8.7	8.7	7.74	11.25	3.75	20.0	13.0
Total	f	23.0	23.0	23.0	23.0	80.0	80.0	80.0	80.0

Key (SD=Strongly Disagree, D=Disagree, U=Undecided, A= Agree, SA=Strongly Agree)
LP- Land Preparation
UAI- Use of Appropriate Inputs
CA- Creation of Awareness

farmers were asked to respond to statement designed to elicit positive knowledge of performance resulting to land preparation. A 5-point likert scale was constructed to record these responses. Table 5 show results on public extension services in relation to land preparation.

The results in 5 showed that majority of the farmers (72.5%) received extension services on land preparation from private sector. Perhaps this is due to the diverse nature of private sector extension where land preparation machines are readily provided to try and promote return on investment as well as enabling the farmers to increase their income through increased cane production.

Advice on appropriate use of inputs was one of the activities used to measure private extension services. To elicit information on the use of appropriate input, the farmers were asked to respond to statement designed to elicit positive knowledge of performance resulting to use of appropriate input. A 5-point likert scale was constructed to record these responses. Table 6 show results on public extension services in relation to appropriate use of input.

The results in table 6 showed that majority of the farmers (75%) receive advice on use of appropriate input from private sector.

A comparison of public and private extension services

Table 7 shows a comparison of the role public and private extension play with respect to various cane farming activities. The relevant information was elicited by asking the farmers to state from whom they receive extension services from, followed by their responses to statements designed to elicit positive knowledge of performance to various cane farming activities. A 5-point likert scale was used to record these responses.

The results in table 7 indicate that, public extension has a lesser role in enhancing effectiveness of outgrowers' credit system as compared to private extension services. This was because the majority of the public extension recipients (61.5%) either disagreed or strongly disagreed compared to 47% private extension recipients in terms of advising farmers on various farm activities.

Table 8: Chi-square test for Effectiveness of Outgrowers Credit System by Type of Extension

	Value	df	Asymp. Significance 2 sided
Pearson Chi-square	14.952	18	0.667
No. valid cases	103		

Significance set at (α = 0.05)

Hypotheses testing

The null hypothesis tested stated that there is no significant difference between the public and private extension services in terms of enhancing effectiveness of out-grower's credit system in Kisumu County. Both the public and private sector extension services were measured with respect to advice given to farmers on land preparation, use of appropriate inputs and creation of awareness. The information on public and private extension services with their effects on effectiveness of out-grower's credit was elicited by use of farmers' questionnaire. Testing of this hypothesis was carried out by use of chi-square test and the results are presented in Table 8.

Results in Table 8 indicate that, there was no significant difference between public and private sector extension services. This was because the Pearson chi-square value (14.952) was not significant at $\alpha = 0.05$ ($p>0.05$). The null hypothesis was thus accepted. This result suggests that public and private sector extension services are inadequate in terms of quantity despite the fact that cane farmers require it to realize a positive change.

DISCUSSION

Akroyd and Smith (2007) noted that lack of agricultural services has negatively impacted on food production. Consequently, in many parts of less developed countries, agricultural extension services often bypass or do not reach the rural farmers (FAO, 1997). In most countries extension services provided by the government are supplemented by private sectors. Milu and Jayne (2006) acknowledged that, in developing countries, the private sector extension is extremely diverse. Depending on the particular economic and political situation, the private sector may consist of individual farmers/ farm enterprises of all sizes, agricultural input industries, agro-services enterprises, processing industries, marketing farms and multinational firms. It may also include a wide range of agricultural production and marketing co-operatives, farmers associations and private and voluntary organizations. Despite their differences, all these organizations share a common market orientation. They all try to make profit by selling goods and services. As a result all these private sector organizations have a strong incentive to deliver goods and services (including agricultural extension) efficiently and effectively so as to enhance their ability to survive. Firms that supply agricultural inputs such as seed, chemical fertilizer, pesticides may provide farmers with a wide range of technical and managerial information (through various outreach mechanisms) both to assure that their products are used correctly and also increase agricultural production and income to the farmers. These also motivate customers to buy more products in future (Milu and Jayne 2006). Examples of these private extension agencies are the Muhoroni Sugarcane Outgrowers Company and Chemelil Outgrowers Company, which are currently operating and supporting farmers.

The findings of this study indicated that majority of farmers (82.6%) receive information on credit facility from either from public or private extension providers. The results agree with the findings by Khasiani (1992) who indicated that agricultural technologies might not be adopted if the farmers are not aware of its existence. He continued that lack of awareness acts as a hindrance to the effective participation in agricultural activities. Similarly, Madhur (2000) argued that, impact would be limited if extension is unable to appreciably increase the level of farmers awareness. Further, the results also supports the findings by Mbata (1991) who acknowledged that through extension services the small-scale farmers should be made to understand that credit supervision is for his / her own interest and that, through supervision, credit would be better managed and used for the intended purposes which in turn will increase his productivity and raise their capital base.

The findings of the study also showed that majority of the farmers received extension services on land preparation from private sector. Perhaps this is due to the diverse nature of private sector extension where land preparation machines are readily provided to try and promote return on investment as well as enabling the farmers to increase their income through increased cane production. However, among the farmers who received advice from public extension officers it was noted that the services were not satisfactory. This suggests that perhaps the declining cane production in Kisumu County is due to poor and inadequate land preparation, culminating from inadequate machinery to prepare land for cane growing.

The results further showed that majority of the farmers receive advice on use of appropriate inputs from private sector. This suggests that probably a few farmers may be benefiting as the private sector normally targets potential farmers to maximize the profit from their products. Absence of dependable information to farmers on inputs, on credit and marketing would erode the credibility of extension, hence the rate of adoption by, farmers would be low (FAO, 1994, Khasiani, 1992). However there should be a positive correlation between farmers' link with information sources and adoption (World Bank, 1992 & Chitere, 1995).

This result suggests that public and private sector extension services are inadequate in terms of quantity, that is, in terms of extension agent contact with the farmer despite the fact that cane farmers require it to realize a positive change. Perhaps inadequate extension from government is due to the retrenchment of many staff in the Ministry of Agriculture in the study area (Owuor, 2002).

CONCLUSIONS

Based on the findings of the study a number of conclusions were drawn:

-Public extension service has a role in enhancing effectiveness of the outgrowers' credit system among smallholder cane farmers in Kisumu County. However, the sector needs to enhance the following: provision of advice with respect to, land preparation and use of appropriate inputs.

- That except for inadequate quantity of extension, private extension service plays a greater role in enhancing effectiveness of outgrowers' credit system.

- That in terms of enhancing effectiveness of outgrowers' credits system there was no significant difference between public and private sector extension services.

Recommendations

From the findings of the study, the following recommendations were suggested.

- Intensification of both public and private extension services.
- Strengthening factory extension division.
- Increasing the number of extension personnel.
- Establishing the contribution of extension among other factors in cane production.

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Applying CVM for Economic Valuation of Drinking Water in Iran

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Abstract

Economic valuation of water is useful in the administration and management of water. Population growth and urbanization caused municipal water demand increase in Iran. Limited water resource supply and urban water network capacity raised complexity in water resources management. Present condition suggests using economic value of water as a criterion for allocating policies and feasibility study of urban water supply projects. This study use contingent valuation method for determining economic value of drinking water in Kohkiloye & Boyerahmad province. Required data set were obtained from 177 questionnaires by applying stratified random sampling in 2011 year. From 136 investigated urban households 111 ones are willing to pay more for qualified drinking water. Also, from 41 investigated rural households only 3 ones are willing to pay more for qualified drinking water. Results indicated that economic value of drinking water is 6877 Rial per cubic meter.

Keywords:
Economic Value of Water, Willingness to Pay, Municipal Water Consumption, Contingent Valuation Method, Kohkiloye & Boyerahmad Province

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INTRODUCTION

Iran is one of the arid and semi-arid countries of the world with average precipitation of 251 mm per year. The total renewable water resources of Iran is 130 billion cubic meters, out of which 92 percentages is used for agriculture, 6 percentages for domestic use and services and 2 percentages for industrial uses (Assadollahi, 2009). Rapid population growth and low irrigation efficiency in agricultural sector of Iran have increased the demand for water resources. Therefore, rational management for water supply and demand and optimum use of the available water resources is necessary. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources. Water resources provide variety of products and services for human being include food, drinking water, hygiene, entertainment and hydropower. Water demand amount and variety increase beside water supply limitations in municipal regions cause competition among users and impose pressure on drinking water networks. Widespread network of water in cities, high cost of drinking water supply and important role of water in sustainable development raised complexity in water resource management in most cities of Iran. Water allocation and using water economic value as a criterion for allocating is one of the mentioned complexity in water resource management (Turner *et al.,* 2004). The value of water in alternative uses is important for the rational allocation of water as a scarce resource, whether by regulatory or economic means. Water economic value could be used as a proper framework for water pricing and water allocating policies. Also, benefit-cost analysis of water supply projects mainly uses water economic value for economic benefit determination. Most of development documents in Iran insist on estimating economic value of water in different uses and applying this amount as a criterion for allocating. Fourth development program of Iran noted economic value of water should be calculated in water basins. Also, in Fifth development program of Iran using water economic value for allocating and supplying water resource has been mentioned. Many studies estimate economic value of water in agriculture usage applying parametric and non-parametric methods like production function and mathematical programming (Hussain and Young, 1985, Thompson, 1988, Chakravorty and Roumasset, 1991, He and Tyner, 2004). Against irrigation water, drinking water considered as a final commodity in economical modeling and its economic value determination approach completely different from the situation in which water is a production input like in agriculture and industry (Lehtonen *et al.,* 2003). When water considered as a final commodity, contingent valuation method could properly used for its economic value determination. Many studies use CVM for estimating and calculation economic value of drinking water (Gnedenko and Gorbunova, 1998, Gnedenk *et al.,* 1999, Farlofi *et al.,* 2007, Guha, 2007).

According to the importance of economic water valuation in Kohkiloye and Boyerahmad province, present study estimated economic value of drinking water in municipal and rural districts of mentioned province based on willingness to pay of households for proper quality of drinking water. Estimated WTP for drinking water could be used in benefit-cost analysis of urban water supply projects in Kohkiloye and Boyerahmad province.

MATERIALS AND METHODS

Several approaches applied for economic valuation of water which categorize into two main groups include economic valuation of water as a production input and economic valuation of water as an economic commodity. In agriculture and industry, water used as an input and approaches like production function or mathematical programming applied for economic valuation of water. In municipal usage water treated as a final commodity and water consumers gained utility by using water. Hence, in this case approaches like contingent valuation method, choice modeling and water market transactions have been used for estimating economic value of water (Young, 2005). CVM studies are very popular among mentioned approaches used for economic valuation of drinking water, present study apply CVM for achieving to the foresaid goals.

CVM usually used as a standard and flexible tool for measuring non-use values and non-market use values of natural resources and environment (Hanemann *et al.,* 1991 and Hanemann, 1994). CVM determined individuals WTP in hypothetical scenarios (Lee, 1997). In this approach a hypothetical market for drinking water with proper quality established and some proposed price suggested to individuals for acquiring mentioned commodity. Individual's answer to the proposed prices or bids has been formed based on maximizing utility. As shown below, accepting proposed price means that utility gained by accepting is more than the utility of denying proposed price.

$$U(1, Y-A; S) + \varepsilon_1 \geq U(O, Y; S) + \varepsilon_0 \qquad (1)$$

In above equation U is indirect utility, Y is individual income, A is proposed price or bid and S is social-economical characteristics. Utility difference is as below:

$$\Delta U = U(1, Y-A; S) - U(O, Y; S) + (\varepsilon_1 - \varepsilon_0) \qquad (2)$$

According to the model characteristics logit or probit functional form has been used for estimating valuation function. Considering Pi as the probability of accepting proposed price (A) by individual, logit functional form could be formed as below:

$$P_1 = F_\eta(\Delta U) = \frac{1}{1+\exp(-\Delta u)} = \frac{1}{1+\exp\{-(\alpha - \beta A + \gamma Y + \theta S)\}} \qquad (3)$$

In which $F_\eta(\Delta U)$ is cumulative distribution function. θ, γ and β are regression coefficients and it is expected that θ>0, γ>0 and β≤0. After estimating above logit function it is possible to calculate expected WTP using integral.

Logit regression model coefficients have been determined using maximum likelihood estimator (Lehtonen and *et al.,* 2003). Integral of $F_\eta(\Delta U)$ between 0 to infinity has been calculated based on below equation:

$$E(WTP) = \int_0^\infty F_\eta(\Delta U)dA = \int_0^\infty \left(\frac{1}{1+\exp\{-\alpha^* + \beta A\}}\right)dA \qquad (4)$$

In above equation E(WTP) is expected willingness to pay and α^* is adjusted constant which is constructed as below:

$$[\alpha^* = (\alpha + \gamma Y + \theta S)] \qquad (5)$$

One of the main advantages of logit estimation is that it is possible to investigate change in variables amount on the probability of accepting proposed price by individual i. The probability of bid acceptance by individual defined as below:

$$P_i = F(X_i^* \lambda) = \frac{1}{1+\exp^{X_i^* \lambda}} \qquad (6)$$

In which, X_i^* is the vector of variables and λ is the vector of coefficients. In order to evaluate the effect of each variable quantity change on the probability of bid acceptance, the derivation of above equation has been calculated (Maddala, 1991):

$$\frac{\partial P_i}{\partial X_{ik}} = \frac{\exp^{X_i^* \lambda}}{(1+\exp^{X_i^* \lambda})^2} \lambda_k \qquad (7)$$

This equation generates marginal effect of each variable which is very useful in policy making analysis of model results. Requested data set were obtained through a survey using questionnaires. Mainly, information like education, age, individual satisfaction of drinking water quality and quantity, monthly income and expenditure, water consumption quantity and willingness to pay for drinking water has been asked from each individual by interviewing. Present study used stratified random sampling method for determining the sample size. From 177 sample size 136 and 41 questionnaires gathered from urban and rural districts of Kohkiloye & Boyerahmad province, respectively. Explanatory variables which were used in logit model for estimating economic value of drinking water could be summarized in below table 1.

RESULTS AND DISCUSSION

Investigating sample individuals' satisfaction of drinking water quality showed that 7 percentages of rural individuals and 40 percentages of urban individuals satisfied with present condition of drinking water quality. On the other hand, 93 percentages of investigated rural individuals and 60 percentages of investigated urban

Table 1

Explanatory variables	Description
Region	Dummy variable (1= urban district, 0= rural district)
Water quality	Dummy variable (1=satisfaction from drinking water quality, 0=dissatisfaction from drinking water quality)
Water quantity	Dummy variable (1=satisfaction from drinking water quantity, 0=dissatisfaction from drinking water quantity)
Monthly income	In 1000 Rials
Monthly water consumption	In cubic meter
Family size	-
Proposed price or bid	In 1000 Rials
Family supervisor gender	Dummy variable (1=male, 0=female)
Family supervisor age	-
Family supervisor education	-

individuals dissatisfied with drinking water quality. Reasons of dissatisfaction could be summarized as kidney diseases occurrence, parasite

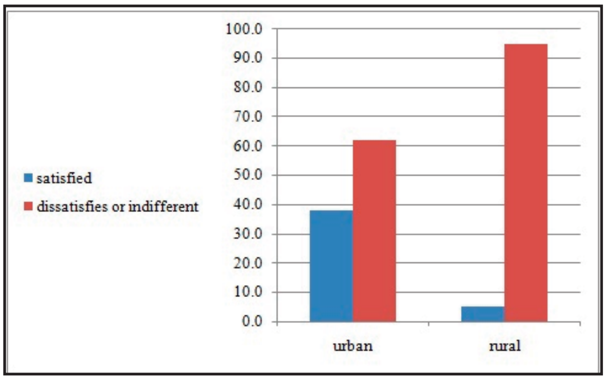

Figure 1: Comparing satisfaction level of drinking water quality in urban and rural districts (percentages).

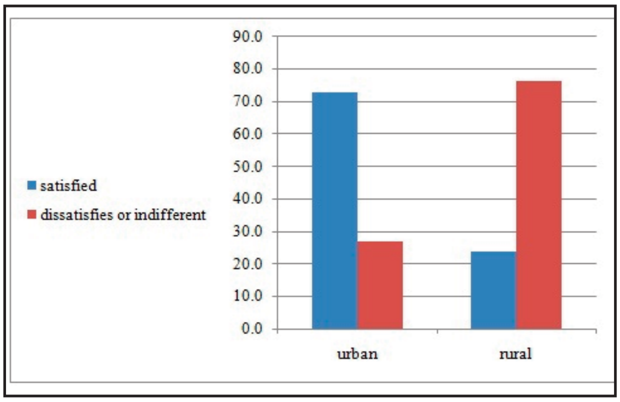

Figure 2: Comparing satisfaction level of drinking water supply in urban and rural districts (percentages).

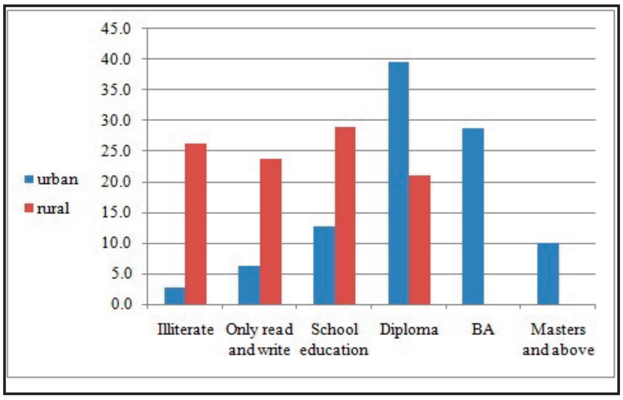

Figure 3: Comparing education level of sample individuals in urban and rural districts (percentages).

diseases occurrence and existence of pollution in rural drinking water.

Investigating sample individuals' satisfaction of drinking water quantity showed 17 percentages in rural districts and 69 percentages in urban districts satisfied by present condition of drinking water quantity or supply. Also, 83 percentages of investigated people in rural districts and 31 percentages in urban districts dissatisfied from drinking water quantity or supply. Reasons of dissatisfaction include water quantity, dissection, and network insufficient pressure. Hence, households forced to use tankers or reserve drinking water.

Investigating sample individuals' education level showed that frequency of diploma degree

Table 2: Comparing willingness to pay in urban and rural districts.

District	Description	Willing to pay more	Will not pay more
Urban districts	Frequency	111	25
	percentages	81	19
Rural districts	Frequency	38	3
	percentages	93	7

Source: research findings.

Table 3: Logit model estimation result.

Variables	Coefficients	S.D.	t-statistics	Marginal Effect
Bid	-0.107	0.042	-2.503	-0.024
Monthly income	0.00064	0.00036	1.76	0.00014
Family supervisor education	0.085	0.041	2.061	0.0192
Region	-1.113	0.679	-1.637	-0.25
Constant	1.834	0.639	2.868	-

Log of likelihood function = -86.5
Percentage of Right Predictions = 0.77
Source: Research findings.

is more in urban districts. Education level frequency of sample is shown in figure 3.

From 136 investigated urban households 111 ones are willing to pay more for qualified drinking water. Also, from 41 investigated rural households only 3 ones are willing to pay more for qualified drinking water.

After estimating different models with explanatory variables, below model select as the best estimations.

Results revealed that bid, monthly income, family supervisor education level and dummy of region variables had direct and statistically significant effects on probability of bid acceptance. Marginal effect value of monthly income variable showed that one unit increase (1000 Rials increase) in monthly income 0.0192 unit increase the probability of bid acceptance. Also, marginal effect of bid showed that 1000 Rials increase in bid amount 0.024 unit decrease the probability of bid acceptance by sample individuals. One level increase in family supervisor education 0.0192 unit increase the mentioned probability amount.

Percentages of right prediction in logit model were 77 percentages. So, 77 percentages of individuals' responses could be simulated by model. Using model coefficients, the amount of α^* calculated ($\alpha^* = 2.171$). Expected quantity of WTP for drinking water consumption equals 213187 Rials per month. Considering average drinking water consumption for each household as 31 cubic meters, value of a cubic meter drinking water equals 6877 Rials.

CONCLUSION

Results revealed that drinking water consumers were willing to pay 6877 Rials per cubic meter in Kohkiloye & Boyerahmad province. This price could be used as a good framework for allocating planning of drinking water. Also, for calculating economic benefits of new drinking water supply projects this value could be used. Applying CVM approach for economic valuation of drinking water provides good view for managers and planners about consumers' demand of drinking water.

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Perceptions of Constraints Affecting Adoption of Women-in-Agriculture Programme Technologies in the Niger Delta, Nigeria

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Abstract

The study focused on constraints affecting the adoption of innovative agricultural technologies disseminated by the Women-in-Agriculture (WIA) unit of the Akwa Ibom Agricultural Development Programme (AKADEP) to its women clientele. The study also ascertained the awareness and adoption levels of such introduced technologies. Findings revealed that respondents were aware of 61.9% of introduced technologies, while only 33.3% were fully adopted. The study also identified seven factors responsible for the non-adoption of women farmers' related technologies. The three highest ranking constraining factors were revealed as; high cost of inputs, low income level of women farmers and lack of regular contact with WIA extension agents. Reasons have been proffered for the relatively low technologies' adoption levels. Recommendations have also been made to enhance the technology adoption level. These include the necessity to introduce only socio- economically and culturally compatible technologies to WIA clientele, a wholesale focus on follow-up activities after initial group based technology introduction activities, and the attachment of a credit scheme to the WIA program.

Keywords:
Constraints to Adoption, Awareness, Agricultural Technologies, Women farmers.

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INTRODUCTION

Agriculture constitutes a large share of national output and employs a majority of the labour force in most developing countries; hence the sector has been integrated into any thinking about development (World Bank, 2003). However, whereas agriculture-led growth played an important role in slashing poverty and transforming the economies of many Asian and Latin American countries, the same has not occurred in Africa, including Nigeria (Diao *et al.,* 2007). According to Baker (2005), technical change is the engine of long-term growth and it becomes technically important through diffusion. This is more so for agricultural production, where the prospect of enhanced production offered by improved agricultural technologies is recognized, according to the World Food Program, as essential to improving the household food security of small scale farmers, raising rural incomes and creating national surplus that can improve the basis for economic growth (WFP, 1998).

Baker (2005) took a retrospective view at Africa's lack of robust economic growth and dearth of modern technology and concluded that technology (especially agricultural technology) diffusion appears to have failed therein. Eicher (1992) revealed that nearly 100% of the increase in food production in the West African sub-region, since 1960, has come from expanded harvest area, rather than improvements in technology, a trend which Sanders (1996) has deemed, inefficient and with negative long term prospects.

Jafry (2000), Brown *et al.,* (2001) and the Directorate for International Development (DFID, 2004), among many other authors and research scientists, revealed that women are the key farmers, food producers and natural resource managers, in most countries of sub-Sahara Africa. This is because they provide 65 – 89% of food, provide nearly half of farm labour, shoulder over 90% of domestic responsibilities and work twice as many hours as men. Akpabio (2005) also reported an African study which revealed that women carry over 80 tonnes of fuel, water and farm produce for a distance of more than one kilometer over the course of a year. Despite all these contribution, the Technical Centre for Agricultural and Rural Cooperation, asserted that women are still restricted in their roles as farmers by unequal rights and unequal access to and control over resources, especially land (CTA, 2000). Women also carry out their work without much help from agricultural support mechanisms such as extension agencies, input suppliers and credit institutions (FAO, 2000).

The Women-in-Agriculture (WIA) sub-component of the Agricultural Development Programme (ADPs) was instituted in 1988 to address gender specific agricultural problems. The focus is on food nutrition, processing, storage and utilization of crop and livestock produce, in order to raise women's income and living standards through business oriented farming and processing strategies. Ever since the introduction of the WIA programme in Nigeria, and with the current emphasis on participatory extension, various efforts have been made to elicit various types and levels of information on the activities and effectiveness of the programme in specific limited areas (states) of Nigeria and the Niger Delta. Akpabio (2005b) reported that the WIA programme in Akwa Ibom State remains less than effective, in terms of its contribution to the upliftment of the economic and socio-psychological status of rural women while Adetoun (2000) in South Western Nigeria, and Eshiett (2007) with reference to Akwa Ibom State, revealed that only a few of the technologies disseminated to WIA clientele have been fully adopted.

The importance of agricultural technologies in the development process cannot be overemphasized. It is against this background that this study sought to ascertain clientele perceptions on reasons for the reported low trend of adoption of agricultural technologies. This study however covers the larger South – South (Niger Delta) region of Nigeria, hence it was decided first of all to ascertain on a wider scale of the Niger Delta, the validity of earlier reports of Akpabio (2005b) and Eshiett (2007). In essence, the study sought to answer pertinent questions relating to: (i) the level of women farmers' awareness of specified innovations introduced through the WIA programme and (ii) respondents' perceptions of constraints affecting adoption of technologies disseminated through the WIA programme in the Niger Delta.

MATERIALS AND METHODS

Study Area

The Niger Delta is located in the Southern part of Nigeria. It spreads over a total land mass of about 75,000 square kilometers. It is inhabited by an estimated 30 million population. The people are distributed into forty ethnic groups in about 13,329 communities/settlements in nine states. It is characterized by wetlands and water bodies, with creeks and rivers criss-crossing the entire Southern parts and is often regarded as the largest wetland in Africa and the third largest in the world (UNDP, 2006). The region is however endowed with natural resources. It has the third largest mangrove forest, with the most extensive fresh water swamp forest and tropical rainforest characterized by great biological diversity. Alongside its immense potentials for agricultural revolution, the study area also hosts vast reserves of non-renewable natural resources, particularly hydrocarbon deposits in oil and gas.

The population for the study comprised all the leaders/representatives of different WIA groups who attended the various one-day interactive fora organized by the ADPs in all states in the region. Relevant data could be collated for five states. These were Akwa Ibom, Cross River, Delta, Edo, and Rivers. All the 267 participants were purposefully utilized for the study, although responses from 250 respondents were eventually utilized for data analysis (viz, table 1). A pre-tested and validated structured Interview Schedule and Focus Group Discussions were utilized to elicit relevant information from the selected sample. These activities were performed with the aid of trained enumerators.

Table 1: Selected Sample

S/N	State	Population	Sample
1	Akwa Ibom	51	51
2	Cross River	60	53
3	Delta	53	48
4	Edo	56	54
5	Rivers	47	44
	TOTAL	**267**	**250**

To ascertain the level of women farmers' awareness and adoption of specified innovations introduced through the WIA program, a list of technologies disseminated through the WIA programme was obtained, after which awareness and adoption scores were computed for each technology. Scores of 0 and 1 were recorded for awareness and non-awareness of disseminated technologies while scores of 2, 1 and 0 were recorded for adopted, discontinued and non-adopted technologies, respectively. A mean cut-off score of 0.5 was adopted to demarcate between technologies for which respondents were either 'aware' or 'not aware', while a cut-off mean score of 1.0 was utilized to differentiate between technologies which have either been 'adopted' or 'not adopted'. In essence, respondents were deemed to be aware of a technology with a mean score of 0.5 and above, while they were not aware of technologies with mean scores of less than 0.5. Similarly, technologies which recorded mean scores of 1.0 and above were perceived as adopted by respondents, unlike technologies with mean scores of less than 1.0, which were regarded as not adopted.

To determine respondents' perceptions of constraints affecting adoption of WIA programme technologies, a list of possible constraints that may hinder the adoption of disseminated technologies was drawn up with the aid of interviews and literature search. A 3-point Likert continuum of agreed (3) undecided (2) and disagreed (1) was employed to compute responses on reasons for non-adoption of WIA technologies. A cut-off mean score of 2.5(3+2+1/3 +0.5) was utilized to differentiate between 'major' and 'minor' factors for non –adoption, where a score of 2.5 and above, was depicted as a 'major' factor for non-adoption, while items with scores below 2.5 were adjudged minor factors.

RESULTS AND DISCUSSION

Awareness and adoption levels of WIA technologies

Tables 2 and 3 show that women farmers

Table 2: Distribution of Respondents based on the extent of Awareness of WIA technologies

	AKADEP Technologies Food Crops	Aware (1)	Not aware (0)	Means	Remarks
1	Cassava/maize/melon planting	230 (92) *	20 (8)	0.92	Aware
2	Yam mini set	124 (49.6)	126 (50.4)	0.49	Not Aware
3	Dry season vegetable	170 (68)	80 (32)	0.68	Aware
4	Wet season vegetable	210 (84)	40 (16)	0.84	Aware
5	Rice cultivation	86 (34.4)	164 (65.6)	0.34	Not Aware
	Processing & Utilization				
6	Soya bean milk/ flour	140 (56)	110 (44)	0.56	Aware
7	Odorless fufu/garri	250 (100)	0 (0)	1.00	Aware
8	Fruit drinks	116 (46.4)	134 (53.6)	0.46	Not Aware
9	Plantain chips processing	210 (84)	40 (16)	0.84	Aware
10	Pineapple chips processing				
	Input use	200 (80)	50 (20)	0.80	Aware
11	Fertilizer use	180(72)	70(28)	0.72	Aware
12	Improved crop varieties e.g. maize	160 (64)	90 (36)	0.64	Aware
13	Agro chemicals e.g. Pesticides	84 (33.6)	166 (66.4)	0.33	Not Aware
14	Improved animal breeds	130 (52)	120 (48)	0.52	
	Agroforestry technology				
15	Snail rearing	124 (49.6)	126 (50.4)	0.49	Aware
16	Plantain /Cocoyam intercropping	196 (78.4)	54 (21.6)	0.78	Aware
17	Afang cultivation	210 (84)	40 (16)	0.84	Aware
18	Bee raising	78 (31.2)	172 (68.8)	0.31	Aware
	Tree crops planting				
19	Improved oil palm seedlings	160 (64)	90 (36)	0.64	Aware
20	Rubber seedlings	90(36)	160 (64)	0.36	Not Aware
21	Improved cocoa seedlings	70 (28)	180(72)	0.28	Not Aware

*-Percentages in parentheses

were aware of 61.9% (13 of 21) introduced technologies, while only 33.3% (7 of 21) of the technologies were eventually adopted. It was also observed on table 3, that respondents adopted 53.9% (7 of 13) of the technologies for which they were aware. A related finding in the course of study revealed that only 59.2% respondents received information on improved agricultural technologies from extension officials of the WIA program, while 20.8% and 20% respondents received information from relatives/friends and husbands, respectively. There is a cause for concern here. This is because an extension program deliberately targeted at women farmers reaches only 59.2% of intended clientele. Many reasons have been proffered for this undesirable situation. These include; long distance from meeting venues and concomitant non-attendance at group meetings (Adetoun, 2000) lack of interpersonal contact, arising from lack of follow-up after group meetings (Udoh, 2001) and lack of relevance of disseminated messages to the amelioration of female farmers livelihood constraints (Reij and Waters-Bayer, 2001) among many others, might have led to clientele' loss of interest in extension offerings.

Table 3 also shows that none of the technologies disseminated to respondents under "input use" and "tree crops planting" classifications was adopted. Odourless fufu/garri (fresh/dried cassava paste) x = 1.96; cassava/maize/melon crops combination (x = 1.76) and intercropping (x = 1.45) were the most adopted technologies. This result corroborates Baker's (2005) and Swinkels and Franzel's (1997) assertion that compatible technologies and technologies that differed very little from the old technologies would diffuse faster since there would be less of an information problem associated with them. Pannell (1999) described four conditions necessary for farmers to adopt innovative technologies, two of which are "awareness of the technology" and "perception that technology promotes farmers objectives". It may be inferred that farmers will adopt more of the technologies for which they are aware. In essence, awareness of technology is a motivating factor for the adoption of technological packages.

Table 3: Distribution of respondents based on the extent of adoption of WIA technologies.

	AKADEP Technologies (Food Crops)	Not Adopted (0)	Discontinued (1)	Adopted (2)	Means**	Remarks
1	Cassava/maize/melon planting	0 (0) *	20 (8)	210 (84)	1.76	Adopted
2	Yam mini set	0 (0)	88 (35.2)	36 (14.4)	0.64	Not Adopted
3	Dry season vegetable	60 (24)	60 (24)	48 (19.2)	0.62	Not Adopted
4	Wet season vegetable	0 (0)	40 (16)	170(68)	1.52	Adopted
5	Rice cultivation	172 (34.4)	0 (0)	0 (0)	0.00	Not Adopted
	Processing & Utilization					
6	Soya bean milk/ flour	10 (4)	70 (28)	60 (24)	0.76	Not Adopted
7	Odourless fufu/garri	0 (0)	10 (4)	240 (96)	1.96	Adopted
8	Fruit drinks	110 (44)	6 (2.4)	0 (0)	0.02	Not Adopted
9	Plantain chips processing	4 (1.6)	16 (6.4)	190 (76)	1.58	Adopted
10	Pineapple chips processing	14 (5.6)	10 (4)	176 (70.4)	1.45	Adopted
	Input Use					
11	Fertilizer use	40 (16)	52 (20.8)	88 (35.2)	0.91	Not Adopted
12	Improved crop varieties e.g maize	24 (9.6)	60 (24)	76 (30.4)	0.84	Not Adopted
13	Agro chemicals eg. pesticides	34 (13.6)	46 (18.4)	4 (1.6)	0.21	Not Adopted
14	Improved animal breeds	40 (16)	20 (8)	60 (24)	0.56	Not Adopted
	Agroforestry technology					
15	Snail rearing	16.(6.4)	24 (9.6)	84 (33.6)	0.76	Not Adopted
16	Plantain /Cocoyam intercropping	12 (4.8)	4 (1.6)	180 (72)	1.45	Adopted
17	Afang cultivation	30 (12)	16 (6.4)	164 (65.6)	1.36	Adopted
18	Bee raising	78 (31.2)	0 (0)	0 (0)	0.00	Not Adopted
	Tree crops planting					
19	Improved oil palm seedlings	140 (56)	20 (8)	0 (0)	0.08	Not Adopted
20	rubber seedlings	82 (32.8)	8 (3.2)	0 (0)	0.03	Not Adopted
21	Improved cocoa seedlings	66 (26.4)	4 (1.6)	0 (0)	0.01	Not Adopted

*-Percentages in parentheses
** Mean Scores calculated, based on total no. of respondents- regardless of the no. of actual recorded responses per innovation.

Hardarker, Huirne and Anderson (1997) however cautioned that high level awareness of technologies does not necessarily translate into higher adoption levels. This is because farmers will only adopt those innovations which are adjudged useful and beneficial to their particular situation. A disaggregated analysis of table 2 reveals relatively high frequencies of "non-awareness" scores that were recorded for some technological offerings which were generally perceived (mean scores) as being "aware" of by respondents (viz; items 3, 6, 12, 14 and 19). Bunch (1982) and Baker (2005) harped on the importance of critical mass in the adoption of innovations. The researchers contended that that there is a higher level of adoption and less discontinuance for a new technology in which the whole community or a critical mass (proportionately larger than average) of farmers are aware of and in which they are interested. They explain reasons for this in terms of traditional communities being accustomed to living in an environment of consensus, and that schemes which entail community risk sharing are more easily imbibed than otherwise.

Constraints affecting adoption of WIA programme technologies

Results as shown on table 3 reveals that respondents perceived 7 of the 21 identified items as possible reasons for the relatively low adoption levels of agricultural technologies introduced through the WIA programme. These are: high cost of inputs (x = 3.0), low income level of women farmers' (x = 2.97) lack of regular contact with extension agents (x =2.82) old age of women farmers in the study area (x = 2.73) poor attitude towards risk and change (x = 2.55) and complexity of introduced technologies (x = 2.55). The above revealed findings find relevance in related literature. Rogers (1995) identified five key characteristics of innovations that determine their adoption potential, including: relative advantage, trialability, compatibility,

Table4: Distribution of respondents based on perception of factors affecting non-adoption of WIA technologies.

	Reasons for Non Adoption/ Discontinuace	Disagreed (1)	Undecided (2)	Agreed (3)	Mean (X)	Remarks
1	High cost of inputs	0(0) *	0(0)	250 (100)	3.00	Major Factor
2	Lack of supporting inputs	88(35.2)	62(24.8)	100(40)	2.05	Minor Factor
3	Problem of diseases / pests	66 (26.4)	34(13.60)	150 (60)	2.33	Minor Factor
4	Non-appropriateness of the technological package to the Local environment	60 (24.1)	68 (27.2)	122 (48.8)	2.25	Minor Factor
5	Non-availability of the improved package	84 (32.80)	16 (6.4)	152 (60.8)	2.28	Minor Factor
6	Non-Profitability of the new technology	188 (75.2)	40 (16)	22 (8.8)	1.16	Minor Factor
7	Superiority of the old technology to the newly introduced one.	174 (69.6)	48 (19.2)	28 (11.2)	1.42	Minor Factor
8	Incompatibility of the new technology with the norms and customs of the local environment	144 (57.6)	60(24)	46 (18.4)	1.60	Minor Factor
9	Lack of clear understanding of the newly introduced package	12(4.8)	104(14.6)	134 (53.6)	2.48	Minor Factor
10	Low level of educational attainment by women farmers in the study area.	48 (19.2)	106 (42.4)	96(38.4)	2.19	Minor Factor
11	Low level of income of women farmers in the area	2 (0.8)	4 (1.6)	244 (97.6)	2.97	Major Factor
12	Insufficient Programs designed to convince and encourage farmers to change	12 (4.8)	144 (59.6)	94 (37.6)	2.32	Minor Factor
13	Women farmers perception of the old technology as better than the new one.	138 (55.2)	68 (29.2)	44 (17.6)	1.62	Minor Factor
14	Inconsistence of the innovation with the existing farming system, values and needs of women farmers in the area	156 (62.4)	36(14.4)	58 (23.2)	1.61	Minor Factor
15	Inadequate information about the newly introduced technological package.	50(20)	58 (23.2)	142(59.2)	2.44	Minor Factor
16	Complexity of the introduced innovation.	44(17.6)	24 (9.6)	182 (92.8)	2.55	Major Factor
17	Failure of some demonstration plots set –up by the extension agents.	138 (55.2)	58(23.2)	54 (21.6)	1.66	MinorFactor
18	Lack of regular contact with extension agents	20(8)	4(1.6)	226(90.4)	2.82	Major Factor
19	Poor attitude of women farmers towards change and risk	8 (3.2)	60 (24)	182 (72.8)	2.70	Major Factor
20	Age of women farmers in the study area	20 (8)	28 (11.2)	202 (80.8)	2.73	Major Factor
21	Lack of access and control over production resources such as land and credit facilities.	8(3.2)	96(38.4)	146(58.4)	2.55	Major Factor

*-Percentages in parentheses

observability and complexity. Reed (2001) identified the most significant of these characteristics, as: high relative advantage, high compatibility and low complexity. Swinkels and Franzel (1997) agreed with the submission above, but also opined that for the female gender, additional incentives for adoption may include factors like, suitability to accepted gender roles, cultural acceptance and compatibility with other enterprises.

High cost of inputs for introduced technologies and low income of respondents' were revealed as the greatest constraints to adoption of introduced technologies. Obinne (1994) and Arokoyo (1996) mentioned low income level of farmers and high cost of inputs as constraints to technology adoption, especially among low income farmers. In that wise, Baker (2005) and Hebinck, Franzel and Richards (2007) asserted that the most successful programmes of agricultural change are those that tie adoption to credit programmes. Udoh (2001) and Eshiett (2007) maintained that contact with extension agents, especially with respect to interpersonal contacts, relate favorably to the adoption of new farm practices and concomitant improved agricultural production. Obinne (1994) and Baker (2005) opined that poor attitude to risk, in terms of excessive risk aversion may severely limit adoption of technological innovations especially among female rural farmers, while Baker (2005) opined that technologies that differed very little from the old technologies would diffuse faster than unrelated technologies, while the older generation may credibly block adoption even if the younger generation co-ordinates. Dove (1991) contended that individuals with insecure tenure will generally be less likely to invest in new technologies that require complementary immobile inputs, while Due, Mudenda and Miller (1993) asserted that although women want to increase the productivity of the resources they control, they face greater obstacles to change. One of such obstacles, according to Reij and Waters-Bayer (2001) is lack of relevance of disseminated messages to the amelioration of female farmers' livelihood constraints. (PLEASE, THIS IS NOT LITT REVIEW. THIS IS SIMPLY A COMPARISON OF FINDINGS WITH RESULTS FROM PREVIOUS STUDIES)

It is obvious that although poor female farmers in the study area are conscious of innovating in order to overcome their present precarious socio-economic situation, they are however precluded from benefiting from opportunities open to them due to various constraining factors, as have been identified above.

CONCLUSION AND RECOMMENDATIONS

It has been revealed that the WIA program, as being implemented in Akwa Ibom State does not reach out to a large number of its intended clientele base. This has resulted in an average level of awareness and concomitant relatively lower level of adoption of innovative technologies disseminated by WIA extension officials. The study also identified seven factors which combine to hinder the adoption of disseminated WIA technologies. The major constraints were: high cost of inputs, low income level of women farmers and lack of regular contact with WIA extension agents. Many reasons, backed by literature, have been proffered for this trend, including the fact that only 59.2 percent respondents regarded WIA extension officials as their source of information on innovative agricultural technologies. In order to enhance the success of the WIA programme in Akwa Ibom State, attempts should be made to ameliorate constraints which hinder extension officials' access to their potential clientele. To aid in this direction, adequate logistic support should be

provided to WIA extension agents so as to help enhance the process of contacting their expectant clientele Technologies slated for dissemination should be compatible to clientele socio-economic and cultural base and emphasis should be focused on follow-up activities, after initial group meetings. This would help to practicalize disseminated technologies on the farms and in the homes of potential adopters of technological innovations. It may also be necessary to attach credit schemes to the WIA program, in terms of linking the various women groups to various credit agencies.

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A Logistic Regression Analysis: Agro-Technical Factors Impressible from Fish Farming in Rice Fields, North of Iran

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Abstract

This study was carried out to identify Technical-Agronomic Factors Impressible from Fish Farming in Rice Fields. This investigation carried out by descriptive survey during July-August 2009. Studied cities including Talesh, Rezvanshahr and Masal set in Tavalesh region near to Caspian Sea, North of Iran. The questionnaire validity and reliability were determined to enhance the dependability of the results. Data were collected from 184 respondents (61 adopters and 123 non-adopters) randomly sampled from selected villages and analyzed using logistic regression analysis. Results showed that there was a significant positive relationship ($p<0.05$) between biological control of pests in rice fields and the fish farming in rice fields. Also, there was a significant negative relationship ($p<0.10$) between the fish farming in rice fields and variables of quantity using pesticide of Diazinon in rice fields and number of plows in rice fields.

Keywords:
Rice-Fish Farming, Technical-Agronomic Factors, Pest, Weed, Plow, Fertilizer

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INTRODUCTION

The earliest records of fish culture in rice-fields originate from China, circa 2000 years ago, followed by India, 1500 years ago. Other countries with a recorded history of rice-fish culture are Indonesia, Malaysia, Thailand, Japan, Madagascar, Italy, Russia, Vietnam (Rothuis, 1998), Egypt, Philippines, Bangladesh, Cambodia, Korea and other countries (Saikia and Das, 2008; Frei and Becker, 2005; Halwart, 1998). Also in northern Iran rice-fish farming is a new farming system (Karami *et al.,* 2006; Noorhosseini and Allahyari, 2010). Integrated rice-fish farming offers a solution to economic problem of farmers by contributing to food, income and nutrition. Not only the adequate supply of carbohydrate, but also the supply of animal protein is significant through rice-fish farming. Fish, particularly small fish, are rich in micronutrients and vitamins, and thus human nutrition can be greatly improved through fish consumption (Larsen et al., 2000; Ahmed and Garnett, 2011; Noorhosseini and Mohammadi, 2010). Many reports suggest that integrated rice-fish farming is ecologically sound because fish improve soil fertility by increasing the availability of nitrogen and phosphorus (Giap *et al.,* 2005; Dugan et al., 2006; Noorhosseini, 2012).The feeding behavior of fish in rice fields causes aeration of the water. Integrated rice-fish farming is also being regarded as an important element of integrated pest management (IPM) in rice crops (Berg, 2001; Hilbrands and Yzerman, 2004). At the farm level rice-fish integration reduces use of fertilizer, pesticides and herbicides in the field. Such reduction of costs lowers farmer's economic load and increases their additional income from fish sale (Noorhosseini, 2010; Noorhosseini and Radjabi, 2010). Also, integrated rice-fish farming gave higher rice yields and fetched higher gross margin than sole rice cropping system (Das *et al.,* 2002; Hossain et al., 2005). Ahmed and Garnett (2011) Reported that higher yields can be achieved by increasing inputs in the integrated farming system. Integrated rice-fish farming also provides various socioeconomic and environmental benefits. Nevertheless, only a small number of farmers are involved in integrated rice-fish farming due to a lack of technical knowledge, and an aversion to the risks associated with flood and drought. In addition, Ahmed *et al.,* (2011) Reported that rice-fish farming is as production efficient as rice monoculture and that integrated performs better in terms of cost and technical efficiency compared with alternate rice-fish farming. However, a lack of technical knowledge of farmers, high production costs and risks associated with flood and drought are inhibiting more widespread adoption of the practice. Our objective was to identify technical-agronomic factors impressible from fish farming in rice fields in north of Iran.

MATERIALS AND METHODS

Studied Location and Survey: This study was carried out by survey during July and August 2009. Studied area including Talesh, Rezvanshahr and Masal set in Tavalesh region of Guilan province near to Caspian Sea, north of Iran (Figure 1). Respondents were selected from rural area and categorized into adopters and non-adopters of integrated rice-fish farming. Totally 184 farmers were selected by stratified random sampling technique using the table for determining the sample from given population developed by Bartlett *et al*., (2001) that including 61 (33.15%) adopters and 123 (66.85%) non-adopters (Table 1). This survey was conducted in using a questionnaire with open-ended questions. The questionnaire was pre-tested by in-

Table 1: Total sample size used in the study area

	Talesh	Masal	Rezvanshahr	Total
IRFF Adopters Population	31	31	17	17
IRFF Adopters Sample Size	19	28	14	14
IRFF Non-adopters Sample Size	38	56	29	29

Source: Survey Results, 2009

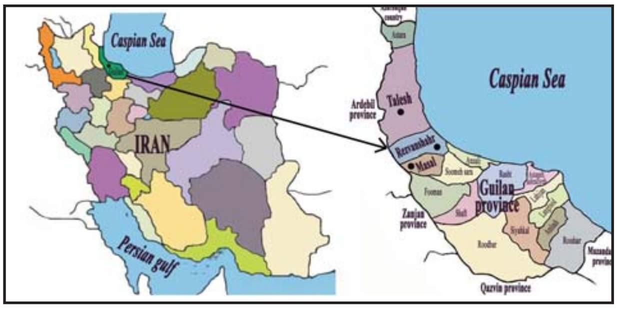

Figure 1: Site of study

terviewing three farmers (not included in the study). After some modifications, it was tested again with 10 other respondents.

Statistical Analysis: The technical-agronomic variables for the two groups were examined using logistic regression model. The dependent variable was the adoption of rice-fish farming. The dependent variable was dichotomized with a value 1 if a farmer was an adopter of integrated rice-fish farming and 0 if non-adopter. The definitions and measurement of variables are present in Table 2. AF, AH, MW, AP, BP and WI were entered in the model as dummy variables. The other variables namely QF, QD and NP were entered as continuous variables. Data analysis was conducted with Statistical Package for Social Sciences (SPSS 18).

The model was specified as follows;

$$Y = f\,(AF, QF, AH, MW, AP, BP, QD, NP, WI)$$

strength of the joint effect of the covariates on probability of adoption among farmers in the zone. The results also showed that the decision on adoption of rice-fish farming is determined by biological control of pests in rice fields (BP), quantity using Diazinon in rice fields (QD) and number of plows in rice fields (NP) which have significant influence. Also, the Wald indicating the relative contribution of individual variable to probability of adoption of rice-fish farming showed that BP (4.538) was the most important factor determining choice of adoption of rice-fish farming among the rice farmers. Generally, the results of logistic regression show that there was a significant positive relationship ($p<0.05$) between biological control of pests in rice fields and the fish farming in rice fields (Table 3). These results were similar to Frei and Becker (2005) and Kathiresan (2007). In other words, fish farming in rice fields reduced the use of chemical control methods that is light reason of rice-fish farming system sustainability. Also, there was a significant negative relationship ($p<0.10$) between the fish farming in rice fields and quantity using Diazinon in rice fields (Table 3). These results are consistent with Saikia and Das (2008), Salehi and Momen Nia (2006). The use of chemical control methods reduced with adoption of rice-fish farming which is also

Table 2: Definition of variables included in the regression model

Dependent variable **Y = Adoption**	**Adopters = 1, Non adopters = 0**
Independent variable	Yes = 1, No = 0
AF = Application of Chemical Fertilizers	Kg/ha
QF = Quantity Using Chemical Fertilizers	Yes = 1, No = 0
AH = Application of Herbicides	Yes = 1, No = 0
MW = Mechanical Control of Weed	Yes = 1, No = 0
AP = Application of Pesticides	Yes = 1, No = 0
BP = Biological Control of Pests	Kg/ha
QD = Quantity Using Diazinon	Number in year
NP = Number of Plows	Very mach = 5, Much = 4, Intermediate = 3, Little = 2, Very
WI = Accessibility to Water Supply for Irrigation	little = 1

RESULTS AND DISCUSSION

The results of the Logit likelihood regression model indicated that the overall predictive power of the model (70.1%) is quite high, while the significant Chi square ($p<0.01$) is indicative of compatible with sustainable agriculture. Since many fish species feed partly on the aquatic fauna, it has been assumed that they can act as biological control agents in rice fields. Concurrent rice and fish culture decrease pesticides appli-

Table 3: Logistic regression coefficients of the technical-agronomic factors affecting adoption of rice-fish farming

	B	S.E.	Wald	Sig.
AF	-19.131	25320.477	0.000	0.999
QF	0.000	0.001	0.005	0.943
AH	-21.476	18858.287	0.000	0.999
MW	20.493	40192.879	0.000	1.000
AP	0.611	0.558	1.200	0.273
BP	0.996	0.468	4.538	0.033**
QD	-0.029	0.016	3.311	0.069*
NP	-0.717	0.396	3.273	0.070*
WI	0.112	0.167	0.450	0.502
Constant	20.822	51110.003	0.000	1.000

*** p<0.01, ** p<0.05 and * p<0.10
-2 log likelihood = 204.830
Chi square statistic = 28.943***
Overall Correct predictions = 70.1%

cation compare monoculture (Berg, 2002; Noorhosseini, 2011). In general, common carp, being an omnivorous feeder, seems to be the most promising species in controlling insects and snails [15]. In addition, there was a significant negative relationship (p<0.10) between fish farming in rice fields and number of plows in rice fields (Table 3). According to results, by adoption of rice-fish farming, number of plows was reduced. It seems that the decrease of tillage frequency among adopters, caused by farms occupied by fishes is the time dimension.

CONCLUSION

In general, our results suggest that biological control of pests in rice fields, quantity using Diazinon in rice fields, and numbers of plows in rice fields were the most important technical-agronomic factors impressible from fish farming in rice fields. In other words, adopters of rice-fish farming used less chemical materials in order to control pests and reduce the number of plows. Furthermore, society health and environment sustainability will be saved and they reach more profit that is economical. Also, since aquaculture requires resources such as pond, land, water and other inputs, poor farmers cannot afford the requirements. As a target to understand and meet their needs and to access the common water resources available in their rice-fields, rice-fish farming is the most appropriate technology in recent times.

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