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Competitiveness of Fish Farming in Lagos State, Nigeria: An Application of Policy Analysis Matrix

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Abstract: This study assessed the competitiveness of commercial fish farming in Nigeria using the Policy Analysis Matrix (PAM) on a sample of 84 fish farmers in Lagos State, Nigeria. A multistage sampling technique was employed to select the number of respondents in the study area. Both primary and secondary data were utilized for the analysis. The study employed two fish production outputs including smoked and fresh fish products. The PAM results revealed that both products were both privately and socially profitable. However, smoked fish was more profitable of the two products. Furthermore, results revealed that outputs from the production outputs (smoked and fresh fish) are taxed as revealed by the nominal protection coefficients on output and input. This was further confirmed by the Effective protection coefficient (EPC) and Subsidy ratio to producers (SRP) values. The study recommends that government should ensure a level of policy intervention in aquaculture production in which fish farmers are given incentives that will incentivize them to improve productivity and the quality of fish produced and processed. One of these incentives can be in the form of provision of improved farm technologies for production and processing in order to enhance competitiveness.

KEY WORDS: Competitiveness, Fish Farming, Policy Analysis Matrix

1.0 INTRODUCTION

Nigeria is typically an agrarian economy and agriculture plays a crucial role in the economic development of Nigeria. For example, it provides about 70 percent of employment, it provides the bulk of its own food needs, feed and export a wide variety of agricultural goods such as cocoa, rubber among other cash crops (FAO, 1992; Iwe, 2004; Eyo, 2008; Odusina, 2008). A complementary sector to agriculture is fish farming providing a veritable source of animal protein and increased nourishment for the wellbeing of the Nigerian populace. Fresh, smoked and frozen fish are the most common types of fish consumed in Nigeria (Veliu et al, 2009).

Fish consumption accounts for about 40 percent of animal protein consumption in Nigeria. Fish farming is increasingly becoming a vibrant and dynamic commercial sector in Nigeria, rife with investment and employment opportunities. Industry data shows that fish consumption in Nigeria is only met by additional imports of about 740,000MT[1] per year. Therefore, making locally-produced fish more readily available to Nigerian consumers will ensure faster and fresher access to one of the healthiest sources of animal protein. However, producing high-grade fish that are globally competitive with strong nutritional content is a challenge for many farmers. Availability of quality and affordable fish feed and fingerlings, credit, and improved production techniques are challenges faced by the sector towards enhancing its competitiveness. Kudi et al. (2008) estimated that the demand-supply gap of 1.96 million metric tonnes exists nationally with import making up the short fall at a cost of almost US$ 0.5 billion per year. The production shortage in the fishery sector is further exacerbated by an upsurge in population growth.

[1] MT means Metric Tonnes

More so, aquaculture is seen as a complementary sector to agriculture particularly observed in the potential usefulness of fish pond in water conservation and storage. If a low-lying area supplied by watershed is dammed to form a fish pond, the water can be saved, which could otherwise have been wasted and can be used in drier season irrigation of crops (Veliu *et al.*, 2009). Similarly, rice-fish farming, maize-fish farming has also been practiced. This involves the production of fish in swampy rice fields, maize cultivated to serve as feed supplements for the reared fishes to obtain incremental benefit with little investment (Amao *et al.*, 2006).

Fish is very important in the diet of many Nigerians, high in nutritional value with complete array of amino acids, vitamins and minerals (Akinrotimi, *et al.*, 2007). In addition, fish products are relatively cheaper compared to beef, pork and other animal protein sources in the country (Amao *et al.*, 2006). FAO (2007) reported that fish contribute more than 60% of the world supply of protein, especially in the developing countries. In Nigeria, fish supply is from four major sources *viz.*, artisanal fisheries, industrial trawlers, aquaculture and imported frozen fish. Production from aquaculture is increasing compared to artisanal sources and supplied between 5 – 22% of total domestic fish production between 2000– 2007 (FDF, 2007).

Nonetheless, this increasing production is not able to meet the increasing rate of consumption because of the wide gap between fish demand and supply which is on the rise as a result of population explosion in the country in recent years (Falaye and Jenyo-Oni, 2009). Throughout Nigeria, the last few years witnessed a rapid expansion in aquaculture. Available data showed that fish production from aquaculture ranges from 15,840 metric tonnes in 1991 to 25,720MT in the year 2000 and 86,350MT in 2009 (FDF, 2010). However, substantial evidence exist that a great deal of fish production from home stead farms, rural aquaculture and small scale fish farms scattered all over the country are not documented (Akinrotimi *et al.*, 2007) However, Anetekhai, (2004) observed that production varies from 0.5MT/ha in small scale to as much as 10mt/ha in large scale for earthen ponds and this largely depends on level of management intensity of the production system.

According to Warren (2005), increased fish productivity has the potential to translate into higher yields to meet domestic needs, while increased trade domestically and internally can fuel economic growth to help finance the poverty reduction agenda. Therefore, enhancing productivity is a key in this regard. To be competitive and achieve global relevance, the aquaculture subsector in Nigeria must be able to sustain itself through adequate production supply in quality and quantity against the increasing demand by expanding and imploring new ideas and technology. It must also maintain its market share as a formidable source of animal protein as against meat at private and social market amidst changes in both domestic and international policies. This is the reason why a study on competitiveness of aquaculture is highly imperative to inform policies targeted at enhancing the sector particularly with respect to increasing revenue generation and improving the welfare of the farmers.

The concept of competitiveness encompasses a variety of factors including changes in nominal exchange rates, relative prices, and production costs (Dohlman *et al.*, 2003). These factors are expedient at informing profitability in fish production. Information on these factors will also inform policy makers on the necessary actions required to develop the sector towards achieving the transformation agenda of the present administrative dispensation and thereby informing investors on appropriate areas of intervention to achieve the needed results.

This study was therefore aimed at examining the effects of government policy on competitiveness and the comparative advantage of aquaculture using Lagos State, Nigeria as a case study. Policies are the instruments of action that governments employ to effect change. Several principal categories of policies are used to bring about change in agriculture. One of such is agricultural price policy. Two main types of price policy instruments can be used to alter prices of agricultural outputs or inputs. Quotas, tariffs, or subsidies on imports and quotas, taxes, or subsidies on exports directly decrease or increase amounts traded internationally and thus raise or lower domestic prices; these policies apply only to volumes traded internationally, not to domestic production. Domestic taxes or subsidies, in contrast, create transfers between the government treasury and domestic producers or consumers. Some cause a divergence between domestic and world prices; others do not.

2.0 MATERIALS AND METHODS

2.1 Analytical framework

This study employed the Policy Analysis Matrix (PAM) for the analysis. The policy analysis matrix (PAM) is a computational framework developed by Monke and Pearson (1989), and augmented by Masters and Winter-Nelson (1995) as a result of developments in price distortion. PAM‘s approach is based on estimation of budgets using market prices and social opportunity cost and it is used to measure efficiency in production, comparative advantage and the degree of government intervention (impact of policy) on commodity production. It is a product of two accounting identities (Table 1). The first identity defines profitability as the difference between revenues and costs, measured in either private or social terms. The second identity measures the effects of divergence (distorting policies and/or market failures) as the difference between observed private values and social values that would prevailed if divergence were removed. There are two types of profits—private profits evaluated at market prices and social profits evaluated at social or efficiency prices. If there are no market distortions, the two are often the same. If, however, there are market failures or distortions then the two diverges from one another. Their divergence acts as a signal for policy intervention.

The data in the first row of the PAM framework provide a measure of private profitability, defined as the difference between observed revenue and cost. This captures the competitiveness of the agricultural system given current technologies, prices of input, output values and policy transfer. The second row of the PAM is used to measure social profit which is calculated at shadow price. The social profit reflects social opportunity costs and it measure efficiency and comparative advantage. A positive social profit indicates that the system uses scarce resources efficiently and contributes to national income (Nelson and Panggabean, 1991; Keyser, 2006). A negative social profit indicates social inefficiencies and suggests that production at social costs exceed the costs of import, thus indicating that the sector cannot survive without government intervention at the margin (Keyser, 2006). The final row of the matrix represents transfers that come into play due to policy-induced market distortions. This captures the divergences between the first row (measured at private prices) and the second row (measured at social prices). The difference between private and social values of costs, revenues and profits can be explained by policy interventions (Mohanty, *et al.,* 2003; Wiendiyati, *et al.,* 2002; Esmaeili, 2008). The Policy Analysis Matrix (PAM) therefore aims to analyze the impact of governmental intervention policies represented in the policies for goods, such as support and taxes on inputs and outputs.

Several important indicators such as the nominal protection coefficient (NPC), effective protection coefficient EPC), domestic cost ratio (DRC), subsidy ratio to producer (SRP), private cost ratio (PCR), profitability coefficient (PC) which are useful in asserting the level of competitiveness between agricultural production systems can be calculated from the PAM framework (See Monke and Pearson, 1989; Masters and Winter-Nelson, 1995 for details on how these indicators are estimated).

2.2 Some Calculations Deduced from the PAM Framework:

2.2.1. Private Profitability

The data entered in the first row of the PAM model provide a measure of private profitability. The term private refers to observed revenues and costs reflecting actual market prices received or paid by farmers, merchants, or processors in the agricultural system. The private, or actual, market prices thus incorporate the underlying economic costs and valuations plus the effects of all policies and market failures. In Table1, private profits, D, are the difference between revenues (A) and costs (B + C); and all four entries in the top row are measured in observed prices. The calculation begins with the construction of separate budgets for farming, marketing, and processing.

The private profitability calculations show the competitiveness of the agricultural system, given current technologies, output values, input costs, and policy transfers.

Private profit is given as: $D=A-(B+C)$..1

The assumptions are given thus:

- If private profits are negative ($D<0$), operators are earning a subnormal rate of return and thus can be expected to exit from this activity unless something changes to increase profits to at least a normal level ($D = 0$).
- Alternatively, positive private profits ($D > 0$) are an indication of supernormal returns and should lead to future expansion of the system ceteris paribus.

2.2.2 Private Cost Ratio

The private cost ratio (PCR) is used in measuring competitiveness. It shows the private efficiency of the processors and is an indication of how much one can afford to pay domestic factors (including a normal return to capital) and still remain competitive.

PCR = C / A-B 2

The assumption is given thus:

- When PCR>1 indicates that the resource cost is greater than the value added and thus, it is not profitable to process the commodity.
- If PCR<1 indicates that the value added is greater than the resource cost thus, it is profitable.
- If PCR=1 indicates the breakeven point.

2.2.3 Social Profitability

The second row of the policy analysis matrix utilizes social prices. These variables measure comparative advantage or efficiency in the agricultural commodity system. Efficient production outcomes are achieved when an economy's resources are used in activities that create the highest levels of output and income. Social profits, H, are therefore efficiency measure because outputs, E, and inputs, F + G, are valued in prices that reflect scarcity values or social opportunity costs. Social profits, like the private analogue, are the difference between revenues and costs, all measured in social prices.

Social profitability is given as: H = E – (F + G)..3

The assumptions are given thus:

- When (H>0) indicates that the system uses scarce resource efficiently and the commodity has a static comparative advantage.
- If (H<0) indicates that the system cannot sustain its current output without assistance from the government, thereby resulting to waste.

2.3 Domestic Resource Cost (DRC)

DRC is the cost at social prices of non-tradable domestic resources used in the production of the commodity divided by the value added at social prices. If DRC < 1, it implies that the production of the commodity represents an efficient use of domestic resources (i.e., has a comparative advantage) compared to imports. DRC > 1 implies that the domestic costs needed to produce the commodity exceed the value added at social or world market prices, and thus the production of the commodity is not efficient in the use of domestic resources (i.e., it lacks a comparative advantage).

The domestic resource cost (DRC) framework of analysis offers a way of empirically measuring comparative advantage by generating quantitative indicators of the efficiency of using domestic resources to produce a given commodity, as measured against the possibilities of trade.

The calculation for DRC is given thus:

$$DRC = G / E\text{-}F \quad \text{......4}$$

The assumption of DRC is given thus:

- If DRC<1 the processing of the commodity in the country is competitive and enjoys protection.
- If DRC>1 it signifies that the country has a disadvantage in production of analysing goods.

- When DRC = 1 the economy neither gains, nor saves foreign exchange through domestic processing.

2.4 Sensitivity Analysis

Due to the static nature of the Policy Analysis Matrix, it has often been criticised. However, to ameliorate this issue, sensitivity analysis is often employed to examine the impact of changes in parameters on the private and social profitability measures (Monke and Pearson, 1989). Sensitivity analysis is important, because technical coefficients used in constructing enterprise budgets (e.g. yields, use of inputs) are often mean values calculated from a range of observed values, and because prices used in calculating social profitability (including the shadow foreign exchange rate) are often estimated prices or projected prices. For this study, a farm revenue and exchange rate were varied (20% increase and decrease respectively) following Ogbe *et al.* (2011) and Adeoye and Oni (2013).

2.4 Divergence/Policy Transfer

The measurement of divergence and transfer effect of policies is carried out in the third (bottom) row of the Policy Analysis Matrix. Divergence between the observed private (actual market) price and the estimated social (efficiency) price must be explained by the effects of policy or by the existence of market failures. Distorting policies that lead to an inefficient use of resources enhance the stated divergence.

3.0 Data and Modelling Assumptions

3.1 Study Area

The area of study for this project is Lagos State, Nigeria. Lagos State, with an area of 3,568.6 km^2 and an estimated population of 17.5 million in 2006, is the smallest (in terms of land mass) and most densely populated state in Nigeria. With a growth rate of 3.2

percent, the State currently boasts of a population of over 21 Million people. Of this population, Metropolitan Lagos, an area covering 37 percent of the land area of Lagos State is home to over 85 percent of the State population. Lagos state has a coastline which stretches up to 10 percent of its landmass. In addition, over 20 percent of its landmass comprises fresh, brackish and marine waters. The state also has a fair share of both saline and freshwater mangroves with their associated features which sprawl about 30 percent of the entire landmass.

3.2 Data Source

Primary and secondary data were used. The primary source of information were observation and the use of well structured questionnaire to get information on productivity, wages, prices, cost structure, and returns among fish farmers in the study area. Data were collected for production and processing of fish from fish farmers within local government areas in Lagos State[2], Nigeria. The secondary data were sought from the Institute of Oceanography and maritime, Lagos and the FAO-fishstat (2009) on the production of Aquaculture in Lagos state, Nigeria, Central Bank of Nigeria and the National Bureau of Statistics (NBS).

3.3 Sampling Technique

A multistage sampling procedure was used to select the respondents for the study. The first stage involved purposive selection of three ADP zones in the state (Epe, Badagry and Eti-osa). The second stage involved the random selection two local government areas (LGAs) from the identified ADP zones. The third stage was the random selection of 14 fish farmers from each of the identified local government areas with probability

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[2] For an annotated map of the local government areas in the study area, Lagos State, Nigeria, see Figure 1 in the appendix

proportionate to the size of LGAs. A total of 84 respondents (fish farmers) were used for the analysis.

The study made used of data for yields, input use, market and farm gate prices of inputs and outputs. Information on transportation cost, port charges, storage costs, production subsidy import/export tariffs and exchange rate which were obtained from the Customs department , Central Bank of Nigeria and the National Bureau of Statistics (NBS). The PAM constructed for this study made use of farm budget values (sales revenue and input cost) obtained for aquaculture production systems considered for assessment. Further estimations in the PAM were based on World reference price and subsidized prices, and these were used as reference prices for computing social prices for output and input respectively.

The US FOB Gulf price was used as reference price for fish. The world prices were adjusted for transportation cost to be comparable with farm gate price. For imported commodities, social prices at the farm gate were calculated by adding transportation cost, port charges, tariffs to the respective CIF price (calculated by adding ocean freight charges to FOB price) in domestic currency. The social price of land is the opportunity cost of land. The opportunity cost of land in this study was taken to be the net return (profit) of the competing agricultural production system. The opportunity cost of land for catfish farming production is therefore the net return (profit) that would be earned from the next best alternative production system. Following Yao (1993) in Ogbe et al (2011) and Mamza et al (2014), the social valuation of labour was obtained by dividing labour into peak-season and off-peak season components. The wage rate in the peak-season is the opportunity cost of labour for the period considered and the opportunity cost of labour in the off peak season is half the prevailing wage rate. With this, social price of labour as considered in this study is calculated by:

$$P_L = \frac{Wp + 0.5\,Wo}{2} \quad \ldots\ldots 5$$

Where:

P_L = Social price of labour;

Wp = prevailing wage rate in peak season;

Wo = prevailing wage rate in off peak season.

4.0 RESULTS AND DISCUSSION

4.1 Level of Profitability and Divergences of Aquaculture in Lagos State, Nigeria

The profitability level and effective transfer (divergences) are shown in Table 2 below. The result reveals that aquaculture production was both privately and socially profitable in both production systems (fresh and smoked). The positive private profit from both production systems implies that fish production marketed both as fresh or smoked fish are competitive given current technologies, prices of inputs and outputs, and policy. More so, producers are earning supernormal return. Smoked fish production was more profitable with private profit of ₦ 8,477,280.00 compared to that of fresh fish at ₦ 4,554,852.78. This can further be confirmed from their PCR values in Table 3 which are less than unity. The PCR values of 0.6922 and 0.7534 were observed for smoked and fresh fish production systems respectively implying that aquaculture production is competitive at the current level of technologies, outputs and policy intervention. These results are corroborated with the findings of a report on aquaculture value chain analysis in the Niger Delta in 2011 by the Foundation for Partnership Initiatives in the Niger Delta (PIND). The results showed evidence of increased competitiveness of fish (whether smoked or fresh) in most of the south-eastern States of Nigeria and Lagos State (PIND, 2011).

On the other hand, Table 2 indicates a positive social profit for aquaculture production in both production systems. This implies that the fish production systems utilize scarce resources efficiently in the production of both commodities and that the system can survive without government interventions at the margin. There was however, a negative divergence between private and social profits in all the ecologies thus suggesting that the net effect of policy intervention reduced profitability of fish production at the farm level in both production systems which were detrimental to producers. Nonetheless, the yield per production determined to a large extent the profitability both at private and social profits thus corroborating the works of Ugwumba and Chukwuji (2010) that reported that the volume of fish harvested implies that the higher the volume harvested, the higher the revenue in their analysis.

4.2 Ratios of Protection Coefficients, Competitiveness and Comparative Advantage of Aquaculture Production

The summary of ratios of protection coefficient, competitiveness and comparative advantage of aquaculture production for the two production systems are presented in Table 3. The table shows NPCO coefficient values of less than unity indicating that domestic farm gate price is less than the international price aquaculture output and that policies were decreasing the market price to a level of approximately 33% below the international price for catfish production. This suggests that fish production (smoked and fresh) is not protected by policy and that substantial output tax applies and this has been argued by some authors (Amao *et al*, 2006; Kudi *et al.*, 2008; Veliu *et al.*, 2009).

NPCI values of greater than unity indicate that the input costs in all the processing were higher than the world reference price thereby indicating that government is not providing incentives to the farmers. This is substantiated in the high cost of inputs that had been a constraint to several farmers and this has been reported by several authors in the past such as Ugwumba and Chukwuji (2010) and confirmed by this study.

EPC values reveals the degree of protection accorded to the value added process also had values less than unity for both production systems and as such gives the indication that producers were not protected through policy intervention on value added processes. In this regard, the EPC values of 0.4429 and 0.3802 for smoked and fresh fish respectively indicate the absence of protection and negative incentive to the fish farmers. Similarly, the DRC coefficients for both production systems were less than unity indicating that the value of domestic resources used in the production is lower than the value added. This implies an efficient use of domestic resources in production process and that production in the area was socially profitable. Consequently, the study area has a comparative advantage in production of fish. Smoked fish production was the most profitable in terms of use of domestic factor owing to lower DRC value of 0.3065. This is corroborated by a study on aquaculture value chain production by Veliu *et al.*, (2009) using Lagos State as a case study and aquaculture analysis by PIND (2011). The social benefit cost ratio (SCBR) which is another measure for assessing efficiency in the use of fixed factor also confirmed the result of DRC ratio obtained.

Subsidy ratio to producer (SRP) is a measure of the level of transfers. Subsidy ratio to producer (SRP) indicates the level of transfers from divergences as a proportion of undistorted value of the system revenue (Monke and Pearson, 1989). It shows the extent to which farmers revenue have been increased or decreased because of policy. Table 3 indicates a negative SRP values for the two products of -0.4171 and -0.4335 respectively which suggests that there is a decrease in gross revenue for the products and this further confirms that the farmers were taxed by policy.

4.3 Sensitivity Analysis for Aquaculture Production

The PAM approach has been criticized because of its static nature and the results are consider by some to be unrealistic in a dynamic setting (Nelson and Pangabean, 1991). In order to solve this problem, for this study, farm revenue and exchange rate were varied (20% increase and decrease respectively) following Ogbe et al (2011) and Adeoye and Oni (2013). The result of the sensitivity analysis as revealed in both Tables 4 and 5 showed that 20% increase in output lead to improvement in competitiveness and comparative advantage in fish production for both production systems (smoked and fresh fish). This was indicated by the PCR, DRC and SCBR ratios. However, 20% increase in exchange rate had no effect on PCR but a positive effect on comparative advantage. The summary of the sensitivity analysis results revealed that improvement in fish output improved the competitiveness of the products while increase in exchange rate had effect on comparative advantage level of both products.

5.0 CONCLUSION

This study has revealed that the production of fish both as smoked and fresh fish production is economically efficient, competitive and maintained a comparative advantage. The analysis of the findings of the study submitted that there is a dire need for the removal of policy distortions by the government to increase the incentive for producers to expand production while leveraging on effective usage of the domestic resources to improve output. The study also showed that the production systems are efficient in both smoked fish and fresh fish production systems thereby justifying the need for intensified effort and policy attention on aquaculture production if the developmental agenda of the present administration in Nigeria is to be achieved. This is particularly true in the area of improvement in agricultural productivity and the goal for the attainment of food self-sufficiency in the country is to be successfully achieved.

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APPENDIX 1: TABLES

Table 1: Pam Framework

	COST			
	Revenue	**Tradable**	**Domestic Factor**	**Profit**
Private price	A	B	C	D
Social price	E	F	G	H
Divergence	I	J	K	L

Source: Monke & Pearson (1989)

Where:

Private profit = A – B – C = D

Social profit = E - F – G = H

Output Transfers, I = A – E

Input transfers, J = B – F

Factor Transfers, K = C – G; Net Transfers L = D – H; or L = I – J - K

Table 2: Policy Analysis Matrix for Aquaculture Production in Lagos State, ₦/Kg

Fish Product	Private Profitability	Social Profitability	Divergence
Smoked Fish	8,477,280.00	43,120,181.61	-34,642,901.61
Fresh Fish	4,554,852.78	34,663,753.67	-30,108,900.89

Source: Author's computation

Table 3: Summaries of Ratio of Competitiveness, Comparable Advantage and Protection in Aquaculture Production

Indicators	Production Systems	
	Smoked Fish	Fresh Fish
NPCO	0.6667	0.6667
NPCI	1.3333	1.3333
EPC	0.4429	0.3802
SRP	-0.4171	-0.4335
PCR	0.6922	0.7534
DRC	0.3065	0.3865
SCBR	0.4808	0.5009

Source: Author's Computation

Table 4: Sensitivity Analysis of Smoked Fish Production

Indicators	Base value	20% increase in output	20% decrease in output	20% increase in exchange rate	20% decrease in exchange rate
PCR	0.6922	0.5768	0.8652	0.6922	0.6922
DRC	0.3065	0.2555	0.3832	0.2992	0.3101
SCBR	0.4808	0.4426	0.5382	0.4767	0.4889
NPCO	0.6667	0.6667	0.6667	0.6551	0.6777
NPCI	1.3333	1.3333	1.3333	1.3124	1.3402
EPC	0.4429	0.4429	0.4429	0.4311	0.4511
SRP	-0.4171	-0.4171	-0.4171	-0.4287	-0.4012

Source: Author's Computation

Table 5: Sensitivity Analysis of Fresh Fish Production

Indicators	Base value	20% increase in output	20% decrease in output	20% increase in exchange rate	20% decrease in exchange rate
PCR	0.7534	0.6278	0.9417	0.7534	0.7534
DRC	0.3865	0.3587	0.4181	0.3787	0.3909
SCBR	0.5009	0.4675	0.5510	0.4980	0.5111
NPCO	0.6667	0.6667	0.6667	0.5988	0.6701
NPCI	1.3333	1.3333	1.3333	1.2512	1.4006
EPC	0.4429	0.3802	0.3802	0.3791	0.4488
SRP	-0.4335	-0.4335	-0.4335	-0.4518	-0.4422

Source: Author's Computation

APPENDIX 2: FIGURE

Figure 1: Map of Local Government Areas in Lagos State