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Palm oil marketing and distribution pattern in Imo state, Nigeria: An application of linear programming model.

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The major objective of the study is to determine the optimal pattern of palm oil shipment that minimizes total cost of transportation in Imo state of Nigeria. Data for the study were collected by the use of questionnaire from distributors/marketers of palm oil product in the study area. These data were analysed using linear programming model to determine the optimal pattern of palm oil marketing/ distribution from the supply regions (origins) to the demand regions (destinations).The findings showed that minimized objective of the overall transportation cost of shipping the commodity to the recommended routes was only ₦473,458 against ₦576,628 actual total transportation cost. The patterns of palm oil shipment that minimized total cost of transportation recommended by the programme were Orlu-Lagos, Owerri-Abuja and Owerri-Lagos. These routes and quantities of palm oil shipped were found to minimize the total cost of transportation over the period the study was carried out. The research therefore concluded that it is more advisable for palm oil distributors and would-be marketers in the study area to adopt these routes when moving their commodity from the origins to the destinations with a view to making more profit and to be more economically efficient in their distribution pattern. On the basis of the findings, the study therefore suggested that government should provide a conducive environment for the distribution of commodities across the regions by developing cost saving and faster means of transportation systems such as rail and water to enhance movement at lower cost and reducing on-transit spoilage.

Key words: Marketing, Palm oil, Storage, minimization and Linear Programming and Nigeria

Background to the Study

Palm oil marketing is concerned with all stages of operation that aid movement of the produce from the producer to the final consumer. These include: assemblage, storage, transportation, grading and financing. Marketing of palm oil in Nigeria takes place in homes, road sides, local/periodic market centres and stalls. These can be both wholesale and retail types in both rural and urban centers. Generally, palm oil is transported from the supply regions of Southern Nigeria to the demand regions of Northern Nigeria. Lagos, the center of economic activities of Nigeria receives most of the palm oil shipped from the supply regions for onward delivery for export activities. Price of palm oil is largely affected by production or output of the palm oil within the year and general inflation rate in the country.

After processing palm oil, the next thing is to distribute to place(s) where the commodity is needed. This is accomplished through packaging and transportation to the destinations. A good place to start is the market because this is where majority of Nigerians shop for their food. Smaller pack e.g. bottle and gallons are dispensed on the spot from larger containers like tins and drums. The buyer brings in his container and pays for the content only. These pack sizes are usually household size. The larger pack sizes of 18 liter tins are sold with the container, while the drum is not. The buyer bringing his drum to turn from the seller's into his. Alternatively, buyer may pay a deposit for a drum and return it latter for refund.

Major distribution points for palm oil ranges from market stalls, wholesale points, palm oil depots or beaches and supermarkets. Each of these points is characterized by activities of trading associations or unionism which does not permit free entry into the business of palm oil marketing as the case may be. This compels distributors to register with some heavy amount of money to join the union, buy kola and beer etc, for the union members before being allowed to sell his goods from that location. Thus, the members fix price of palm oil through the union and force members to sell at that price.

Each agricultural zone in the state i.e. Owerri, Orlu and Okigwe has what is called palm oil beach/centre from where all purchases, packaging and consequently distribution or transportation of to remote areas across the country are made. The means of transportation is usually by road.Distribution and marketing of agricultural products are as essential as the product itself. Though palm oil is produced in Southern Nigeria, it needs be evenly and efficiently distributed if it must serve the needs of the greater population. For instance, in a consumer survey of Western Nigeria, both quantitative and qualitative deficiencies in protein intake were reported (Udoh, 2005), the study identified among others, inefficient distribution as being responsible for this situation.

Past policies have aimed at increasing agricultural productivity through increased investment in agronomic and production systems research. Efforts have also been made to restructure the agricultural sector by removing every element of control in the supply and pricing of agricultural produce through the abolition of marketing boards, and reducing level of subsidies on agricultural inputs.

This latter policy has contributed enormously to the erratic price variations in agricultural produce observed in recent times (Okoh and Akintola, 2005). Not much emphasis has been placed on evaluation and development of marketing system in agriculture. Policy formulation has therefore failed to take cognizance of the fact that production and marketing constitute a continuum and that the absence of development in one retards progress in the other (Olayemi, 1972).

Previous studies on the marketing and pricing of food stuffs in different parts of Nigeria have concluded that the marketing and pricing information transmission mechanism are inefficient although there are many buyers and sellers in the market (Dittoh, 1994). The paucity of physical infrastructure such as storage facilities, transportation system, access roads, communication channels and inadequacy of economic data for planning and research are some of factors identified as source of inefficiency. Others include: a high level of intermediaries in the marketing/distributing chain, high concentration of food stuff marketing at wholesale level as well as high erratic prices which will further depress the level of agricultural production (Okoh, 2005). Thus, the study contends that imbalance in demand and supply of palm oil exists primarily due to inefficiency in distribution of this commodity across the region. This further leads to price differential in different parts of the country. The study therefore investigates the optimal pattern of palm oil shipment that minimizes total cost of transportation in the study area.

Methodology

The Study Area

Imo state is located in the South – Eastern area of Nigeria and shares boundaries with Anambra, Abia, Delta and Rivers states. The state has a total land area of about 19,000 square kilometers and a population of about 3.38million people (NPC, 2006). The people of the state are mostly rural which makes their occupational distribution tilted towards agricultural production.

The climate is of two types: the dry and wet seasons with intervening cold and dry harmattan period usually experienced during December and January. The state has an annual rainfall ranges from 2000 _ 2500mm while maximum average temperature ranges between 30 - 35 degrees centigrade (Imo ADP, 2009). With this climatic pattern and few sizeable expanse of arable land due to high population density, the farmers in the area grow crops like yam, cassava, maize, fruits and vegetable among some cash crops like oil palm, coconut and plantain. Hence, there are a total of 303,333 farm families in agricultural production in the state.

Sample Selection

In order to get a representative sample and to achieve the objectives of the study, the sample design was based on Imo state Agricultural Development Project's (Imo ADP's) zoning of the state's 27 local government areas into 3 zones in consonance with ecological characteristics and cultural practices. Purposive sampling was adopted in selecting the local government areas and the villages while random sampling was adopted to collect information from the list of marketers involved in palm oil marketing. The purposive sampling was adopted for convenient sake since the error term will not be estimated. The sampling frame was respondents who moved more than 10 drum of palm oil in the state while the sample design was a list of randomly selected marketers. The questionnaire method was used to collect information from the respondent augmented by personal observation. Variables on which data were collected included: respondent's socio-economic characteristic, profitability of palm oil enterprise, demand and supply pattern of palm oil in the state. The study therefore covered 3zones of the state, 9 local government area, 27 villages and 108 respondents.

Data Analysis

The tools of analysis employed for analyzing the study data were descriptive and linear programming model. The descriptive statistical tool comprised frequency counts, percentages, means and modes used to analyse the socio- economic characteristics of the respondents.

The linear programming model was used to determine the optimal pattern of palm oil shipment from the supply regions to the demand regions.

The linear programming model

The objective of transportation model is to meet a set of restraints at minimum cost. It seeks to supply the product deficit locations from surplus quantities available in the locations at minimum cost Beneke and Winterboer, (1973).

Transportation problem involves the determination of optimal shipment patterns (Olayemi, and Onyenweaku, 1999). It arises when the objective is to optimize (i.e. minimize) the use of resources which are limited to all intended activities. In solving this problem, there are "n" origins (called supply regions) that can supply "m" destinations (called demand regions) with specific commodity. Where m is not necessarily equal to n. There is also the quantity of the commodity available at the i-th origin, ai; and the quantity of the commodity required at the j-th destination, bj and unit cost of transportation, ti of moving the commodity from the i-th origin to the j-th destination.

It is evident that the problem is that of constrained cost minimization. The condition that $\sum ai = \sum bi$ means that total quantity available for distribution must be equal to the total capacity available at the destination. That is, total supply is equal to total demand. But in practice, the quantity of commodity available x_{ij} may not necessarily equal a_{ij} or b_{ij} because each a_{ij} may be distributed from i-origin to more than one j-destination and each j-destination may receive consignment from more than one origin, provided of course, that the total quantity of the product distributed from all n origins is equal to the total assigned to m destinations. When total demand exceeds total supply, a dummy origin (supply region) is introduced to provide the excess demand (deficit) and when total supply exceeds total demand, a dummy destination (demand region) is created to receive the excess quantity.

Onyenweaku (1980), Onyenwaku et al, (1981) and Onyenwaku et al, (1982) formulated a spatial equilibrium model for the analysis of inter-regional competition in Nigerian agriculture. More specifically, the study was designed to determine the optimal distribution of crop production among the various producing regions in the country and the transportation pattern between the consuming regions in the country. The crop activities involved were maize, rice, sorghum, millet and cowpea. Study objectives were achieved through the use of a spatial linear programming model comprising 80 real activities and 84 constraints. 56 transportation activities were included in the model to allow for commodities movement from the surplus to the deficit regions. Quantity of produce available was considered to be the limiting factor to crop distribution in each producing region while quantity required in was limiting to the consuming regions.

Following the above, the study problem is to find the marketing and transportation scheme in palm oil marketing in Imo state of Nigeria which minimizes the total cost of transportation of palm oil while satisfying regional demands for the produce. This problem is stated mathematically as follows:

$$\text{Min. } Z = \sum_{i=1}^{n} \sum_{j=1}^{m} t_{ij}X_{ij} \quad \ldots\ldots(1)$$

$$\text{Subject to: } \sum_{i=1}^{m} X_{ij} = b_j, \quad j=1,2,\ldots m \ldots\ldots(2)$$

That is, the quantity of the product shipped to a demand region is equal to the quantity required in that region.

$$\sum_{j=1}^{n} X_{ij} = a_i, \quad i=1,2,\ldots n \ldots\ldots(3)$$

That is, the quantity of the product shipped out of any supply region is equal to the quantity available in that region.

$$\sum_{i=1}^{n} a_i = \sum_{j=1}^{m} b_j \quad \ldots\ldots(4)$$

That is, the quantity of the product available in the supply regions is equal to the total quantity required in the demand regions.

$$X_{ij} \geq 0, \text{ for all } i \text{ and } j \ldots\ldots(5)$$

This restriction simply requires that the quantities of the commodity shipped are non-negative.

Generally,

$$\text{Minimize } Z = \sum_{i=1}^{n} \sum_{j=1}^{m} t_{ij}X_{ij} \quad \ldots\ldots(6)$$

Subject to:

$$\sum_{i=1}^{m} X_{ij} \geq b_j, \quad j=1,2,\ldots n \ldots\ldots(7)$$

The quantity of the product shipped to the demand region is equal to or greater than the quantity available in that region.

$$\sum_{i=1}^{m} X_{ij} \leq a_i, \quad j=1,2,\ldots m \ldots\ldots(8)$$

The quantity of the product shipped to the supply region is equal to or less than the quantity required in the region and,

$X_{ij} \geq 0$, for all i and j…………………………………...(9)

Notations Used

i = 1, 2, 3,…,n denote the supply regions (origin)
j = 1, 2, 3,…,n denote the demand regions (destinations)
X_{ij} = the quantity of the product moved from the i-th supply region
t_{ij} = the unit cost of transportation from the i-th supply region to the j- th demand region.
a_i = the quantity of the product available at the i-th supply region
b_j = the quantity of the product required at the j-th demand region.
Given the above, the optimal pattern of palm oil shipment which minimizes total transportation cost is determined by solving the following linear programming problem:
Minimise $Z = x_{11} + x_{12} + x_{13} + x_{21} + x_{22} + x_{23} + x_{31} + x_{32} + x_{33}$
Subject to:

$$\left.\begin{array}{l} x_{11} + x_{21} + x_{31} = b_{11} \\ x_{12} + x_{22} + x_{32} = b_{12} \\ x_{13} + x_{23} + x_{33} = b_{13} \end{array}\right\} \text{ Demand constraints}$$

$$\left.\begin{array}{l} x_{11} + x_{12} + x_{13} = a_{11} \\ X_{21} + x_{22} + x_{23} = a_{21} \\ x_{31} + x_{32} + x_{33} = a_{31} \end{array}\right\} \text{ Supply constraints}$$

$x_{11}, x_{12}, x_{13}, \ldots, x_{33} > 0$

The linear programming model equivalent to the transportation problem involves 9 variables and 6 constraints.

Activities in the model

x_{11} = Shipment from Okigwe to Abuja
x_{12} = shipment from Okigwe to Lagos
x_{13} = Shipment from Orlu to Onitsha
x_{21} = Shipment from Orlu Abuja
x_{22} = Shipment from orlu to Lagos
x_{23} = Shipment from Orlu to Onitsha
x_{31} = Shipment from Owerri to Abuja
x_{32} = Shipment from Owerri to Lagos
x_{33} = Shipment from Owerri to Onitsha

Restrictions or constraints in the model

$R0_1$ =Quantity required in Abuja i.e. b11
$R0_2$ = Quantity required in Lagos i.e. b12
$R0_3$ = Quantity required in Onitsha i.e. b13
$R0_4$ = Quantity available at okigwe I.e. a11
$R0_5$ = Quantity available at Orlu i.e. a21
$R0_6$ = Quantity available at Owerri i.e. a31

Review of Empirical Issues on Transportation Problem

Shamsudin, (2008) in his analysis of transportation optimization model of palm oil products for northern peninsular, Malaysia, mathematical programming models were developed to solve the crude palm oil (CPO) and the palm kernel (PK) transportation problems for northern peninsular Malaysia. These products from the mills were sent to their respective destinations, the refineries and the crushers.

The two transportation problems were solved to get the mills-to-refineries and mill-to-crushers optimal assignments using distance minimization as the objective function. The solutions revealed similar mills-to-refineries and mills-to-crushers assignments because CPO and PK are proportionate in quantity, truck capacities are homogeneous for each product, and refineries and crushers are located at identical locations. The research was then extended to look into the location problem of the refineries, the crushers, and a proposed pulp manufacturing facility that use empty fruit bunch as the raw material. Similar programming models were written and solved at selective choice of central potential sites, using optimal distance minimization as the selection criteria. The preferred locations for the three refineries are Perai, Bagan Serai and Terong, while for the crushers the best sites are Perai, Kuala Kurau and Terong. The two solutions are not the same due to the different individual processing capacities of the refineries and the crushers. As for the site of a proposed pulp manufacturing facility the most central location is Bagan Serai.

Zuhaimy and Fadzli (2007) also examined the Least Cost and Highest Demand Procedure as feasible solution for Dedicated Vehicle Routing Problem (DVRP). The paper presents various issues concerning VRP, focusing on a dedicated vehicle routine problem (DVRP), which is one variation in the problem. The VRP and its dedicated counterparts, the DVRP are introduced with the objective of finding the minimum routing traveled for one vehicle within a predetermine network using deterministic cost and quantity. In solving the VRP, its initial feasible solution does have a role in determining the final optimal solution. Here, two procedure algorithms namely the least cost and the demand priority are proposed as the initial feasible solution for the DVRP.

The most fundamental and well-studied routing problem is without doubt the Traveling Salesman Problem (TSP) while the Vehicle Routing Problem (VRP) is a generalization of the TSP. The VRP is to determine m vehicle routes, where a route is a tour that begins at the depots, visits a set of customers in a given order and returns to the depots. All customers must be visited exactly once and the total customer demand of a route must not exceed the vehicle capacity with the objective of minimizing the overall distribution costs.

Table 1: Socio-Economic Characteristics of Respondents

	FREQUENCY	PERCENTAGE (%)
	A: Gender Of The Respondents	
Male	65	64.81
Female	35	35.19
Total	108	100
	B: Age Distribution of Respondents	
< 30 Years	8	11.37
30-39	22	20.37
40-49	28	24.07
50-59	37	33.33
> 60	13	12.96
T0TAL	108	100
	C : MARITAL STATUS OF RESPONDENTS	
Married	93	85.19
Single	11	10.81
Widowed	4	4.00
Total	108	100
	D : LEVEL OF EDUCATION	
No education	10	18.52
Primary	40	55.55
Secondary	38	20.37
Higher Institution	20	5.56
Total	108	100
	E : YEARS OF EXPERIENCE	
< 1	8	5.55
1-5	29	29.63
6-10	40	27.77
> 10	31	37.04
Total	108	100

Field Survey, 2010.

The tasks performed by the processors do not require them to acquire education as a necessity. The non-processors mostly carry the product across the shores of their state and as such need to break language barrier. Majority of the respondents (about 77.77%) for both group are within the age group of 30-59 years. This age group is the most active and productive group of the population of any society. Few of the respondents are less than 30 years of age. Youth despise this kind of business because of its nature. It is a strenuous and tasking enterprise and its operation carried out under dirty environment which is the reason youths don't normally want to be involved

Achuthan; et al (2003) investigated the capacitated vehicle routing problem (CVRP) that deals with the distribution of a single commodity from a centralized depot to a number of specified customer locations with known demands. The CVRP considered in this paper assumes common vehicle capacity, fixed or variable number of vehicles, and an objective to minimize the total distance traveled by all the vehicles. This paper develops several new cutting planes for this problem, and uses them in an exact branch-and-cut algorithm. Two of the new cutting planes are based on a specified structure of an optimal solution and its existence. Computational results are reported for 1,650 simulated Euclidean problems as well as 24 standard literature test problems; solved problems range in size from 15-100 customers. A comparative analysis demonstrates the significant computational benefit of the proposed method. The capacitated vehicle routing problem (CVRP) considered in this paper is the following: A set of n - 1 customers with known locations and requirements for some commodity are to be supplied from a single depot using a set of delivery vehicles, each with a prescribed capacity. The problem is to determine the delivery routes, one for each vehicle, that minimize the total distance traveled by all the vehicles and that satisfy the following restrictions: All customer requirements are met; each customer appears on exactly one route, and the vehicle capacities are not violated.

Results and Discussion

Table 1 shows the socio-economic characteristics of the respondents. Men dominate women in palm oil marketing business in both sections. The respondents acquired one level of education or the other. 81.48% of the respondents processing the palm oil marketed were literates while 18.52% were illiterates. On the other hand,

Table 2: Summary of Optimum Plan and Shadow prices of Activity

Activity	Optimal Level	Shadow price(₦)	Opportunity Cost(₦)
Okigwe-Abuja(x_{11})	0	808	7
Okigwe-Lagos(x_{12})	0	452	8
Okigwe-Onitsha(x_{13})	0	700	504
Orlu- Abuja(x_{21})	0	13	13
Orlu- Lagos(x_{22})	160	0	0
Orlu- Onitsha(x_{23})	0	26	355
Owerri-Abuja(x_{31})	252	0	0
Owerri-Lagos(x_{32})	222	0	0
Owerri-Onitsha(x_{33})	0	11	389

Source: field Survey, 2010

however, all the respondents among the non-processors of palm oil stored and marketed in the study area had formal education. Hence, illiteracy is common among the processors.

The Linear Programming Model

The optimum patterns of palm oil distribution under the conditions of the programming model and

the transportation model is a special case of the linear programming model. The figures for the relevant programming from the original source shows a classic transportation model transformation of the transportation problem into its equivalent linear programming model expressed in the matrix format. Three origins or suppliers (i.e. Okigwe, Orlu and Owerri) with 15 units each palm oil must be shipped to three destinations or cities (i.e. Abuja, Lagos and Onitsha) with specified demand. The

numbers in the table are the unit shipping cost. The goal is to find a distribution schedule that minimizes the total cost of shipments.

shadow prices of activities are summarized in table 2. Only activities Orlu- Lagos (x_{22}), Owerri-Abuja (x_{31}) and Owerri-Lagos (x_{32}) respectively are recommended by the programme. These activities have zero opportunity cost i.e. nothing is lost (or foregone) in order to produce additional unit of these activities. Shipment from Okigwe-Abuja (x_{11}) has the least opportunity cost of ₦7 while shipment from Owerri-Onitsha(x_{33}) has the largest opportunity cost of ₦389. This finding is in agreement with that of Onyenweaku (1980) that the pattern of commodity flows relates to the consumption habits of the individual consuming regions. The high demand of palm oil in the North and Lagos is related to the fact that most of the industries and households are concentrated in these areas.

An examination of the shadow prices of the excluded activities reveals the weak position of the shipment to Onitsha and from Okigwe against any other activity. Shadow prices of activities indicate the amount by which profit would be reduced or cost increased if any of the excluded activity is forced into the programme. Inclusion of 1 drum of palm oil in to the programme in shipment to Onitsha-Abuja would reduce profit by ₦808, Okigwe-Lagos ₦452 and Okigwe-Onitsha ₦700. The higher the shadow price of an excluded activity, the lower the chance of entering into the optimal programme. Therefore, shipment from Owerri-Onitsha with shadow price of ₦11 would have greater chance of being included into the programme than shipment from Orlu-Abuja and Orlu-Onitsha with shadow prices of ₦13 and ₦26 respectively. A comparison of the marketers' actual net income and the optimal income derived from the linear programming model for the activities recommended by the programme is shown in table 3. The table shows that the actual incomes of the recommended locations are far less than the optimal incomes. The entire enterprise has a minimized objective of ₦473,458 against ₦576,628 or 21% cost reduction optimal routes are followed in shipping the commodity from the origins to the destinations. This result is indicative of the discrepancy which exists between actual distribution pattern and optimal distribution pattern. Osuji (1978) attributed this discrepancy to the fact that a linear programming model aims at profit maximization objective alone whereas conventional market middlemen have additional objectives such as the maintenance of a minimum level of family self sufficiency and the criteria for resource allocation and enterprise combination differ in the two

Table 3: A Comparison of Marketers' Income and optimum Income.

Location	Actual Income (₦)	Optimal Income (₦)
Orlu	176,300	208,590
Owerri	297158	368038
	MINIMIZED OBJECTIVE = ₦473,458	

Source: Field Survey, 2010

situations. The traditional marketers might, for non-economic reasons, like to continue shipment to particular destination whether or not it is profitable to do so.

Conclusion

The study focused on the Marketing and Distribution Pattern of palm oil in Imo State, Nigeria. The findings showed that minimized objective of the overall transportation cost of shipping the commodity to the recommended routes was only ₦473,458 against ₦576,628 actual total transportation cost. The pattern of palm oil shipment that minimized total cost of transportation recommended by the programme were Orlu-Lagos, Owerri-Abuja and Owerri-Lagos. The result agreed with findings of Ogunfowora and Fetuga (1975) and Aneke (1977) who found that computerized programmes produced minimized cost and that when analysed economically are better in terms of economic returns than the conventional programmes. The research therefore concluded that it is more advisable for palm oil distributors and would-be marketers in the study area to adopt these routes when moving their commodity from the origins to the destinations with a view to make more profit and to be more economically efficient in their distribution pattern. On the basis of the findings, the study therefore suggested that government should provide a conducive environment for the distribution of commodities across the regions by developing the transportation systems such as rail to enhance movement at lower cost.

References

Achuthan N R, Caccetta L, Hill S P (2003). An improved branch-and-cut algorithm for the capacitated vehicle routing problem.http://eprints.usm.my/10380/1/transportation_optimizationmodel_of pdf.

Aneke R E (1977). Economics of Least Cost Diet for Pigs; A Linear Programming Approach. An unpublished Ph.D Thesis, Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria.

Ditto S (1994). Marketing integration: The case of dry season vegetables in Nigeria. *Issues in African rural development* 2: 89-101.

Imo ADP (2009). Imo State Agricultural Development Project, Planning monitoring and Evaluation Unit, Owerri. Annual Report.

National Population Commission (NPC) 2006. Imo State Population, NPC, Abuja

Ogunfowora O, Fetuga B L (1975). Least cost ration formulation for pig production. *Nig. J.Anim Production. 2(2). December.*

Okoh R N, Akintola J O (2005). Oligopolistic pricing and market integration of cassava roots and products in Delta and Edo states of *Nigeria. J. rural. Econom . Dev* vol. 14(2):21.

Olayemi J K, Onyeweaku C E (1999). Quantitative methods for business decisions. Busode Printers Ltd, SW8/910 Bataye Street, Oke Ado Ibadan, Nigeria.

Osuji, L O (1978). Productivity in traditional agriculture: A study of some selected villages in Imo state of Nigeria. Unpublished PhD Thesis, Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria.

Onyenwaku C E (1980). A linear Programming Analysis of Inter-regional Competition in Nigerian Agriculture. An unpublished PhD Thesis, Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria.

Onyenwaku C E , Ogunfowora O, Falusi A O (1981). Spatial Equilibrium Analysis of Nigeria Agriculture. *J.Rural Econom. Dev, 12(2).*

Onyenwaku C E, Ogunfowora O, Falusi A O (1982).An Inter-regional programming Model for Agricultural Planning in Nigeria. *Ind.J. Agricultural Econom. 37(4) October :483 – 493.*

Udoh J P, Umoh G S (2005). Marketing of fresh water clam *Galatea parodox Born 1778* in south eastern Nigeria. *J. rural Econom Dev* 14(2):121.

Shamsudin B I (2008). Transportation Optimization Model of Palm oil Products for Northern Peninsular, Malaysia. http/www.accessmylibray.com Accessed on 25 March, 2010.

Zuhaimy I, Mohammad F R (2007). Least Cost and Highest Demand Procedure as feasible solution for Dedicated Vehicle Routing Problem. http://eprints.usm.my/10380/1/transportation_optimization_model_of.pdf accessed on 25 March, 2010