Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.5, No.11, 2014
www.iiste.org

Determinants of Risk and Uncertainty in Oil Palm Nursery

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Abstract

Nigeria is the fourth largest producer of palm oil in the world after Indonesia, Malaysia and Thailand in the order of annual production volume. The industry provides direct and indirect employment to about four million people in twenty-four oil palm growing states in Nigeria and beyond. However, oil palm production commences with planting and nurturing of oil palm seedlings in nursery, which is associated with risk and uncertainty. This study investigates the major determinants of risk and uncertainty in oil palm nursery using Tobit regression model. Findings show that the major determinants of risk and uncertainty in oil palm nursery were incidence of pests, cost of sprouted seeds, lack of financial capital and seed adulteration. Therefore, it is recommended that management of risk and uncertainty in oil palm nursery should involve purchasing sprouted seed from the right source, pest and disease control and ample provision of financial capital.

Keywords: Seed-adulteration, Tenera-hybrid-seed, Financial-capital, Risk-management, Tobit-model

1. Introduction

1.1 Global Importance of Palm oil Commodity

Palm oil accounts for 34% and 63% of annual production and exports respectively of vegetable oils in the world. It is produced in 42 countries and Nigeria is the fourth largest producer in the world (IPPA, 2010). Currently, it is the vegetable oil produced in largest quantity having pushed soybean oil into second position in 2005 (AOCS, 2012) as shown in Figure (Fig.) 1. It is generally the cheapest vegetable oil (Fig. 2), its availability and low cost made it an important component of the increasing intake of oils and fats in the developing world (AOCS, 2012). The oil palm produces Palm oil and Palm kernel oil, with multiplicity of uses including food and non-food uses as well as health benefits. Examples of food use are Cooking Oil, Shortening, Margarines, Vanaspati, Cocoa butter substitutes and as a key ingredient in instant noodle production etc. Examples of non-food use include Oleo-chemicals, Biodiesel and Personal care products.

Health importance of palm oil is derived from its balanced composition of saturated and unsaturated fatty acids e.g. saturated palmitic acid (44%), Monounsaturated oleic acid (40%) and polyunsaturated fatty acids (10%). Others are high carotene content (15 times higher than carrots and 50 times higher than tomatoes). In addition, palm oil is cholesterol-free, no risk of trans-fatty acids; hence it is good substitute of trans-fat, which has high level of cholesterol. It contains vitamin E, tocopherols and highest content of tocotrienols among edible oils. It meets Food and Agriculture Organisations (FAO) of the United Nations and World health organization (WHO) food standard (Darby, 2009). The oil palm originated in West Africa and was taken to Malaysia (then Malaya) by the colonial rulers in the 1870s (AOCS, 2012). The palm belt of Africa runs through Sierra Leone, Liberia, Ivory Coast, Ghana, Togo, Benin, Nigeria, Cameroon, the People's Republic of Congo and the Democratic Republic of Congo. In West Africa, the belt is narrow because of the rapid decline in rainfall northwards. Thus, in Nigeria there are no semi-wild palms north of about 7^oN, except where there are shallow water table such as near the Jos plateau (Corley and Tinker, 2007).

1.2 The Oil Palm Sector in Nigeria

The Nigerian oil palm industry is a viable sector for economic growth and development. Nigeria is the largest producer of palm oil in Africa and the fourth largest in the world (Omoti, 2011). The industry supplies palm oil and palm kernel oil for household consumption and raw materials to other expanding sectors of the economy (Okiy, et. al, 2006). The oil palm contributes 72% of the nation's vegetable oil production estimated at 1.3 million tonnes (FMARD, 2011). Its contributions to Gross Domestic Products (GDP) in 2010 and 2011 were N105 billion and N115 billion respectively (CBN, 2012). This means oil palm fruit contributes an average of 1.0% to crop production subsector and 0.33% to Gross Domestic Products (GDP) in Nigeria for the years 2010 and 2011. The dominance of palm oil over other vegetable oils at the international scene also obtains in our country but there is no statistical data to elucidate Nigeria situation. This is due to paucity of information and documentation that beset the developing nations.

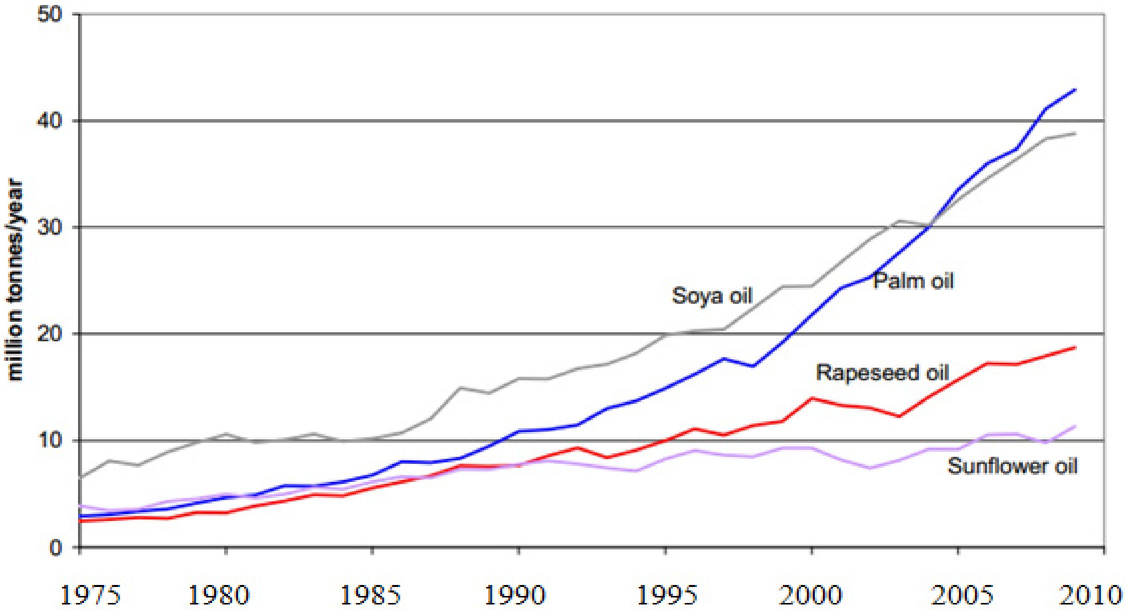

Figure 1: Annual Growth of Major Vegetable oils Production

Source : www.fas.usda.gov/psdonline.

The industry provides direct employment to about four million Nigeria people in twenty-four oil palm growing states in Nigeria and indirectly to other numerous people involved in processing and marketing (Ahmed, 2001). The industry provides rural income, which increases the rural purchasing power for industrial goods. It saves foreign exchange through import substitution. Some privately owned oil palm estates are doing well and currently constitutes the most profitable agricultural enterprise quoted on the Nigerian stock exchange e.g. Okomu oil palm Plc and PRESCO Plc, Edo State. The duo gainfully employed thousands of Nigerians at various levels in their operations. These have demonstrated the economic empower- ring potential of the oil palm investment. Hence, all other oil palm growing states and local governments can invest or empower their farmers to invest into oil palm production. (Badmus et. al., 2005).

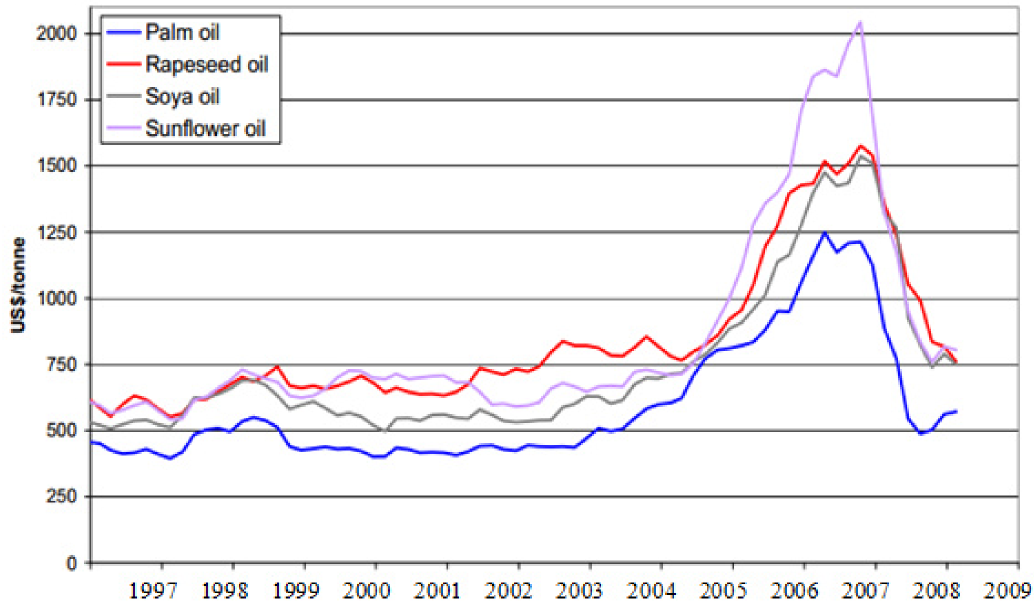

Figure 2: World Major Vegetable oil Prices (US$/Tonne)

Source: www.fao.org/worldfoodsituation/FoodPricesIndex.

The oil palm is grown in Nigeria from latitudes 4^0 - 11^0N; of the Equator from the fresh water swamp forest of the coast to the Northern zone of the Guinea Savannah. Cultivation of oil palm started in 1928 in Nigeria but palm oil production in the country dates back to several centuries (Omoti, 1999). Production and supply of palm oil and palm kernel is mainly from 24 States in Nigeria namely; Abia, Akwa Ibom, Cross River, Rivers, Bayelsa, Imo, Anambra, Ebonyi, Enugu, Delta, Edo, Ondo, Ogun, Osun, Oyo, Ekiti, Benue, Kwara, Kogi, Nasarawa, Plateau, Taraba, Adamawa and Southern Kaduna (Omoti, 2011). The wide coverage of the oil palm belt in the country shows that the industry has employment and wealth creating opportunities in the growing states.

Despite the useful roles of the oil palm, myriads of problems affect different segments of the Nigerian oil palm industry including seed production, plantation establishment, processing, transportation, storage, marketing and consumption, hence the poor growth and development of the industry in the country. However, this study seeks to examine the major determinants of risks and uncertainties in oil palm nursery. Oil palm nursery is the planting and nurturing of sprouted oil palm seeds for a period of nine to twelve months before transplanting to the main field. It is preferably done in two stages, pre-nursery and main nursery for the production of uniform seedlings. Nevertheless, oil palm nursery production is beset with myriad of problems causing risks and uncertainties in the industry.

1.3 Risk and Uncertainty

Risk is uncertainty that affects an individual's welfare, and is often associated with adversity and loss ((Bodie and Merton, 1998). Risk is a situation in which, although the actual outcome of a decision is not known, all the various possible outcomes are known, and the probability associated with each outcome is known, or can be objectively estimated. Uncertainty refers to a situation where no possible outcomes of a decision may be known and the probabilities of occurrence of various possible outcomes are not known and cannot be estimated objectively. Uncertainty is akin to a situation of complete ignorance while risk is akin to a situation of incomplete knowledge (Olayemi, 2004), but in this article these two terms will be used interchangeably.

There are different types of risk; Newbery and Stiglitz (1981) distinguish between *systematic* and *non-systematic* risks; Systematic risks are related to events that repeat over time with a pattern of probabilities that can be analysed in order to have a good estimate of the actuarial odds. On the contrary, non-systematic risks are characterised by very short or imperfect records of their occurrence so, there is difficulties in estimating an objective pattern of their probabilities or distribution of outcomes. An individual risk that is independent or uncorrelated with any other risk is called idiosyncratic risk (OECD, 2009). In other words, idiosyncratic risk is specific to an operation that is not common to all producers in the area e.g. a broken water pipe, which affects an individual reflects idiosyncratic risk (Harwood, *et. al*., 1999). But typically a risk has some degree of correlation with other risks. If there is a high degree of correlation among individuals in the same region or country, the risk is called *systemic risk,* while a catastrophic risk is associated with low frequency but high losses (OECD, 2009).

Risks that affect agriculture could be subdivided into production risk (weather conditions, pests, diseases and technological change), ecological risks (climate change, management of natural resources such as water), market risks (output and input price variability, relationship with the food chain with respect to quality, safety, new products) and finally regulatory or institutional risk - agriculture policies, food safety and environmental regulations – (OECD, 2000). Price risk is systemic, while production risk is both idiosyncratic and systemic (OECD, 2000). Micro (idiosyncratic) risk affects individual or household, meso (covariant) risk affects groups of households or communities while macro (systemic) risks affect region or nations (OECD, 2009).

The objective of this study is to determine the factors that cause risks and uncertainties in oil palm nursery and possible ways of managing such risks and uncertainties for improved productivity. The justification of this study lies in the contribution of this paper in providing information and documentation that could help to ameliorate the problem of poverty alleviation and the enormous investment and time involve in oil palm plantation investment with the subsequent failure that will result after five to seven years of investment cost if wrong planting materials are used. This study will also provide empirical evidence for policy makers to address the needs of the industry.

2.0 Literature Review/Theoretical Frameworks

2.1 Review of past studies on Risk and Uncertainty

Torp and Kilde (1996) state that uncertainty is a parameter in itself, which can be identified, estimated, and controlled. It can be used to guide project resources to maximize benefits and fulfill objectives (avoid risk and exploit opportunities). Samset, (1998) describes uncertainty as follows, Uncertainty characterizes situations where the actual outcome of a particular event or activity is likely to deviate from the estimate or forecast value. Uncertainty is the combined effect of the initiating events and all processes that cause and affect the outcome. Each of the initiating events and processes may be predictable to varying degrees. Their combined effect is usually considered less predictable. Uncertainty is determined to some degree by the type of and number of such processes involved. It follows that decision-making becomes more difficult asuncertainty grows. Furthermore, availability of relevant information increases predictability and reduces uncertainty as seen from the decision maker’s point of view.

In attempt to distinguish between risk and uncertainty, Strand and Oughton (2009), describe risk and uncertainty as almost opposite, in the sense that many authors speak of risk when the uncertainty of the outcomes can be quantified in terms of probabilities, while they speak of uncertainty when probabilities cannot be quantified in a rigorous or valid manner. Samset, (1998) says uncertainty characterises situations where the actual outcome of a particular event or activity is likely to deviate from the estimate or forecast value and the subjective effect of uncertainty that may be either negative or positive is usually termed risk or opportunity respectively. Heijden (1996) states that risk is where there is enough historical precedent, in the form of similar events, to enable us estimate probabilities for various possible outcomes while uncertainty is where the possibility of the event presents itself by means of a cause/effect chain of reasoning, but there is no evidence for judging how likely it could be. Wynn (1992), suggesting further distinction between risk and uncertainty affirms that risk is a situation where odds are known, while uncertainty is where odds are not known.

HMSO, (2004) states that risk management involves all the processes in identifying, assessing and judging risks, assigning ownership, taking actions to mitigate or anticipate them, and monitoring and reviewing progress. Uncertainty management is managing perceived threats, opportunities, and their risk implications but it also involves managing the various sources of uncertainty, which give rise to risk, threat and opportunity (Chapman and Ward, 2002). Risk management is the means by which uncertainty is systematically managed to increase the likelihood of meeting project objectives. In addition, the management of risk and uncertainty begins from appraisal phase; the objectives must be well defined in feasibility study. However, some proposed general steps for uncertainty management are: improved communication between project participants, use of unified terminology and precise calculation of work amounts, active planning and virtual project simulation and use of qualified personnel with experienced staff as well as effective management tools (Migilinskas and Ustinovicius, 2008). The review shows that relevant information, weather conditions, pests, diseases, technological change, climate change, management of natural resources such as water, output and input price variability, relationship with the food chain with respect to quality, safety, new products, agricultural policies, food safety and environmental regulations are among the major factors affecting risks and uncertainties in agriculture.

2.2 Theoretical Framework

The theoretical framework underlying this study is regret theory. It states that people compare the prizes for each state of the world and make choices in order to minimize regret in future (Samset, 1998). For example, suppose:

$$\varphi(E_i)\psi(a_i, b_i) = p_i(x_i - y_i)^3 \qquad (1)$$

where; p_i is the probability that state of the world i occurs; x_i and y_i are the cash payoffs of a and b respectively in this state of the world. Note that in this case, large differences in payoff produce extra large regrets (i.e. the regret function is convex), as proposed by regret theory. Note as well that the cubic function retains the signs (directions) of the regrets. Samset, (1998) postulates that uncertainty and the availability of relevant information are correlated: in the absence of information, uncertainty is high, when information is made available; uncertainty decreases (Figure 8). This is an inverse relationship indicating that when information is low uncertainty is high but when there is sufficient information uncertainty reduces. Torp and Kilde (1996) express that uncertainty is a characteristic associated with all project parameters (time, cost, quality, competence, etc.). Therefore, increase knowledge about each parameter enables us to improve performance.

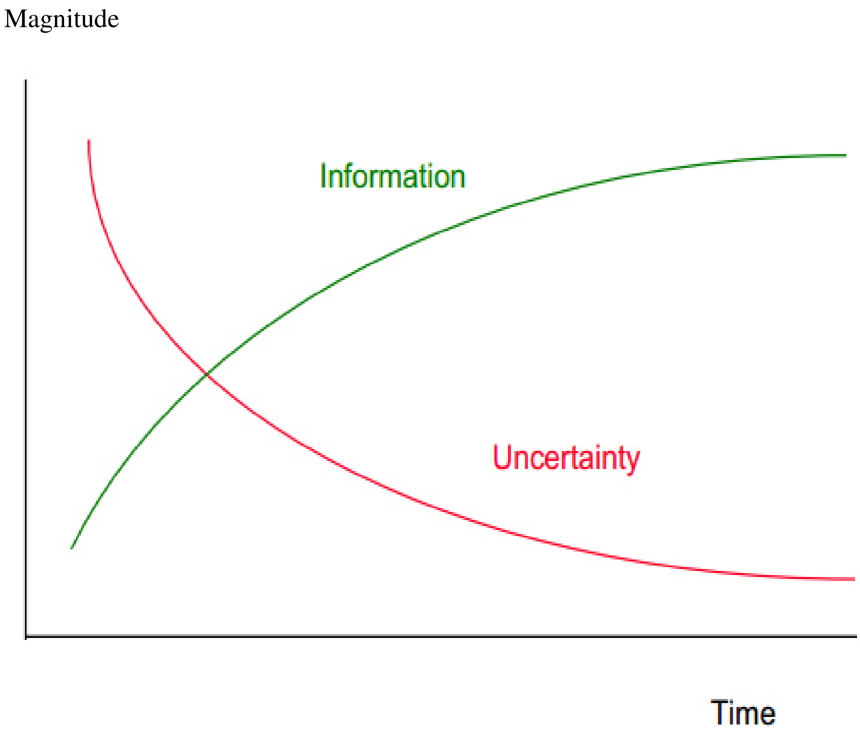

Figure 6: Uncertainty vs. available relevant information in a project

Source: Samset, (1998)

3.0 Methodology

The study was carried out in Ovia North East local government area (LGA) of Edo state, where the main station of the Nigerian Institute for Oil Palm Research (NIFOR) is located. The LGA is bounded on the north by Owan West LGA, on the east by Uhunmwode LGA, on the south by Oredo LGA and on the west by Ovia South West and parts of Ondo state. Primary and secondary sources of data were used for the study. Primary data were obtained by administration of structured questionnaires. Secondary data were obtained from relevant journals, published and unpublished conference papers, text books, Central Bank of Nigeria (CBN), Federal Bureau of Statistics (FBS), etc.

The study used purposive and random sampling procedure. The first stage was purposive selection of Ovia North East LGA and eight villages where the survey was carried out. The second stage was the random selection of nursery operators for questionnaire administration. In each village, available nurseries were identified and numbered. Each number was written on a piece of paper and folded. The folded papers were placed in a container and random selection without replacement was conducted till the required number for that village was attained. Ovia North East LGA was purposively selected because the influence of NIFOR has stimulated oil palm production among farmers in the area. In addition, the selected villages have higher concentration of oil palm nurseries among villages in the local government area, which is stimulated by their proximity to NIFOR. causes risk and uncertainty in oil palm nursery were elicited from farmers. Ninety questionnaires were administered to the selected nursery operators in the chosen eight villages in Ovia North East LGA including Ugbojobo, Ebhoneka, Ekodebore, Ekiadolo, Idumeje, Ikabeto, Okada and Oluku but eighty five (85) were used for analysis. Data collected were analysed using descriptive statistic and qualitative (tobit) regression model.

3.1 The Regression model

The tobit model developed by Tobin (1958) uses censored observations both at the limit e.g. zero and those above it. The tobit model:

$$Yi = X_i\beta i + U_i \quad \text{if } X_i\beta i + U_i > 0 \qquad (2)$$
$$= 0 \quad \text{if } X_i\beta i + U_i \leq 0$$
$$i = 1, 2, \ldots N$$

Where, N = number of observations; Yi = dependent variable; Xi = row vector of independent variables; βi = vector of unknown coefficients and Ui = error term assumed to be independently and normally distributed with zero mean and constant variance σ^2.

However, the dependent variable used in this study is censored from zero to one (0 – 1), so values below zero and those greater than one were not considered. The explained variable is output of nursery at transplanting divided by total number of sprouted seed planted in nursery (number of seedlings produced/number of sprouted seeds purchased). The explanatory variables are the factors causing risk and uncertainty in oil palm nursery. The regression model is specified below.

$$Y = \beta + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} \qquad (3)$$

Where; Y = Output of nursery/number of sprouted seeds planted,
β = intercept, $\beta_1 - \beta_{10}$ = parameters to be estimated,
X_1 = Source of seed (dummy, 1 if source is genuine or 0 otherwise) used as proxy for seed adulteration,
X_2 = Oil palm nursery diseases (dummy, 1 if disease attack is serious or 0 otherwise),
X_3 = Pests of oil palm nursery (dummy, 1 if pest attack is serious or 0 otherwise),
X_4 = Cost of sprouted seed (Amount spent on planted seeds per year in ₦),
X_5 = Amount of credit received by farmers in ₦,
X_6 = Financial capital (dummy, 1 if farmer is using his money or 0 otherwise),
X_7 = Cost of labour per year in ₦,
X_8 = Cost of water supply per year in ₦,

X_9 = Availability of Land with fertile top soil (dummy, 1 if fertile land is available or 0 otherwise)
X_{10} = Number of visits by extension officers per year

4.0 Results and Discussion

4.1 Descriptive statistics

Socio-economic characteristics of the respondents reveal that male were 72% with average age of 44 years while Christianity was their dominant religion (Table 4). Oil palm nursery farms were more at Ugbojobo 22% followed by Ekiadolo 16% as shown in Table 5.

Table 4: Socio-economic characteristics of the Respondents

S/No	Item		Percentage
1	Gender:	Male	72
		Female	13
2	Age:	(mean)	44
3	Religion:	Christianity	73
		Islam	12
4	Marital Status:	Married	55
		Single	24
		Widowed	6
5	Household size:	(mean)	7 persons
6	Educational level:	Primary	13
		Secondary	45
		Technicians	17
		University Degree	10
7	Years of operation (mean)		11

Source: Survey data 2014

Table 5: Distributions of the Respondents

S/No	Villages	No of respondents	Percentage
1	Ugbojobo	19	22
2	Ebhoneka	12	14
3	Ikabeto	7	08
4	Oluku	9	10
5	Ekodobore	6	07
6	Idumegie	7	11
7	Ekiadolo	14	16
8	Okada	11	12

Source: Survey data 2014

Table 6: Correlation Results

	X1	X2	X3	LOGX4	LOGX5	X6	LOGX7	LOGX8	X9	X10
X1	1.000000	0.154409	0.331918	0.810527	0.985341	0.165959	-0.016054	-0.083917	0.780797	0.308906
X2	0.154409	1.000000	-0.285714	-0.010649	0.109526	0.214286	-0.251310	-0.267866	0.371601	0.151392
X3	0.331918	-0.285714	1.000000	0.391339	0.327052	-0.125000	0.203951	0.211169	0.259161	0.003680
LOGX4	0.810527	-0.010649	0.391339	1.000000	0.866978	0.286524	0.525300	0.444603	0.441057	-0.075969
LOGX5	0.985341	0.109526	0.327052	0.866978	1.000000	0.163526	0.107014	0.048915	0.698472	0.223261
X6	0.165959	0.214286	-0.125000	0.286524	0.163526	1.000000	0.191998	0.163334	0.129580	-0.356927
LOGX7	-0.016054	-0.251310	0.203951	0.525300	0.107014	0.191998	1.000000	0.926496	-0.428676	-0.642032
LOGX8	-0.083917	-0.267866	0.211169	0.444603	0.048915	0.163334	0.926496	1.000000	-0.500983	-0.710266
X9	0.780797	0.371601	0.259161	0.441057	0.698472	0.129580	-0.428676	-0.500983	1.000000	0.523856
X10	0.308906	0.151392	0.003680	-0.075969	0.223261	-0.356927	-0.642032	-0.710266	0.523856	1.000000

4.2 Correlation Results

In establishing the regression equation three functional forms were tried. These include linear, double-logarithmic and Semi-logarithmic functions. Semi-logarithmic function was found to be the lead equation. Tests for multicollinearity indicated the existence of significant correlation between seed adulteration and cost of sprouted seed, loan received and availability of rich topsoil as shown in table 6. Cost of labour correlated with cost of water supply. Base on the relevance of each variable, loan received, costs of labour, availability of rich topsoil were dropped. Though seed adulteration correlated with cost of sprouted seeds they were retained because of their importance.

Table 7: Effects of risk factors on oil-palm seedlings

Variable	Coefficient	Std. Error	t - Statistics	P>t	95% Confidence Interval
Constant term	.7778785	.0269706	28.84	0.000	.724184 .8315729
Seed adulteration DX_1	-.0308843	.018389	-1.68	0.097***	-.0674939 .0057253
Nursery diseases DX_2	-.0055309	.0058394	-0.95	0.346	-.0171564 .0060945
Nursery pests DX_3	-.0238032	.0075321	-3.16	0.002*	-.0387984 -.008808
Cost of sprouted seeds X_4	.0982007	.0260561	3.77	0.000*	.0463271 .1500744
Financial capital DX_6	.0315298	.0138803	2.27	0.026**	.0038963 .0591634
High Cost of water supply X_8	-.0112153	.0318977	-0.35	0.726	-.0747188 .0522882
Extension visit X_{10}	-.0001434	.0028377	-0.05	0.960	-.0057928 .005506

*Significant at 1%, **Significant at 5% and ***Significant at 10%.

Source: Results from Field Survey data, 2014

4.3 Regression Results

The results obtained from the regression analysis and marginal effects are shown in Table 7 and 8 respectively. The coefficients were tested for statistical significance at 1%, 5% and 10% level of significance. Costs of sprouted seeds, financial capital, pests of oil palm nursery and seed adulteration were statistically significant and their signs accord a priori expectation. Marginal effects imply that increase in expenditure on sprouted seeds from ₦1,500 have 10% probability of increasing nursery output thus decreasing risks and uncertainty in oil palm nursery whereas a marginal increase in financial capital has 3% probability of increasing nursery output also reducing risks and uncertainty in oil palm nursery. However, marginal increase in incidence of pests and seed adulteration have probabilities up to 2% and 3% respectively of decreasing nursery output thus increasing risks and uncertainty in oil palm nursery.

Table 8: Marginal effects tobit

Marginal effects after tobit
y = Linear prediction (predict)
= .91380465

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.	]	X
B*	-.0308843	.01839	-1.68	0.093	-.066926	.005157	.305882
C*	-.0055309	.00584	-0.95	0.344	-.016976	.005914	.423529
D*	-.0238032	.00753	-3.16	0.002	-.038566	-.009041	.8
E	.0982007	.02606	3.77	0.000	.047132	.14927	1.51115
G*	.0315298	.01388	2.27	0.023	.004325	.058735	.941176
I	-.0112153	.0319	-0.35	0.725	-.073734	.051303	.986775
K	-.0001434	.00284	-0.05	0.960	-.005705	.005418	1.71765

(*) dy/dx is for discrete change of dummy variable from 0 to 1

The implication of this finding is that lack of financial capital is major determinants of risks and uncertainties in oil palm nursery. This is because when fund is available, all other inputs such as sprouted seeds, water supply, pests and diseases control etc. can be attained. Field survey revealed that tenera hybrid seeds/EWS are sold for ₦15,000.00 per bag of 500 sprouted seeds while adulterated seeds are sold for ₦2000.00 per bag of 500 seeds. The difference in price coupled with lack of financial capital is the cause of seed adulteration and could wreck the Nigerian oil palm industry in the near future.

4.4 Description of Some variables

(A) Output of Nursery divided by Total sprouted seeds planted.

This refers to the total number of seedlings at transplanting stage divided by actual number of sprouted seeds purchased. The quotients range from zero to one (0 – 1), which arouse the use of Tobit model. Risk factors do lead to loss of seedlings at nursery, thus reducing the number of seedlings that survive till transplanting stage. The higher the incidence of risk and uncertainty the closer the value to zero (0) and the lower the risk factors the closer the value to one (1). This variable is included in this model as the regressand.

(B) Seed Adulteration

Seed adulteration is the planting of non-Extension Work Seeds (EWS) or non-Tenera hybrid seeds, or seeds that are not produced from the cross-breed of dura and pisifera palms. It also include the picking of oil palm fruits from tenera plantations or non-tenera plantations sprouting them for sale to unsuspecting farmers/nursery operators. Adulteration of oil palm planting materials is a matter of great concern to government, researchers and stakeholders/farmers in the oil palm subsector. Adulteration takes different forms and their consequence generally is low productivity (Okwuagwu, 1997). The Nigerian Institute for Oil palm research (NIFOR) is the only source of tenera hybrid seeds or Extension Work Seeds (EWS) in Nigeria. However, some individuals or groups of individuals do call themselves agents of NIFOR, nurture unimproved oil palm seeds and seedlings from sources other than NIFOR and sell them as NIFOR extension work seeds (EWS) to unsuspecting farmers (Okwuagwu, 1997; NIFOR, $2002_{(a)}$; NIFOR, $2002_{(b)}$). The yield of EWS palm cannot be reproduced without the specific use of its two original parents. This is because at each reproduction process a new genotype is formed with new arrangement of genes and blocks of genes, which determine economy traits. Furthermore, yield of fresh fruit bunch has low heritability, which makes it very difficult to know the yield level of a new genotype without evaluating it over a number of years. Such adulterated planting materials do not only result to poor yield, the chances of new palms being tenera are only 50% (Okwuagwu, 1997). This variable was collected in the field as "source of planting materials" used as proxy for seed adulteration. Nursery operators that purchased sprouted seeds from NIFOR used genuine planting materials while those that procure seeds outside NIFOR adulterated.

(C) Oil palm nursery diseases

Diseases of oil palm nursery are numerous some of them are discussed below. *The brown germ infestation*: This disease is caused by *Aspergillus spp.* And it's a common and widely distributed disease throughout the oil palm growing areas of the world. Its symptom is appearance of brown spots on emerging leaves. It spreads and makes affected tissues to rot. It is usually controlled using the heat method for germinating seeds. And seeds can be treated with fungicide before germination. *Freckle*: This is a fungus disease that affects oil palm seedlings. Control could be achieved by pruning affected leaves or cull the attacked palms. A preventive fungicide may be applied twice a month (2 g of mancozeb or chlorothalonil per litre of water at a rate of one litre of mixture per bed) of 5000 pre-nursery bags (CIRAD, 2008), Diethane M.45, Captan or any other fungicide free of carbon may be used. The Nigerian Institute for Oil palm Research (NIFOR) has Pathology and Entomology research divisions responsible for disease and pest control respectively. Therefore, consult NIFOR for any outbreak of disease or pest. *Anthracnose*: This refers to a complex disease condition in oil palm nursery. This disease condition is caused by various fungi. It leads to the appearance of brown necrotic lesions on the leaves of seedlings usually at the pre-nursery and nursery stages. The appearance of the lesions depends on the causal fungus. It can occur if there is too much shade or excess ambient humidity. It is prevalent throughout oil palm belt and the condition may be reduced by good agronomic practices and adequate farm sanitation. *Blast disease:* is very common in West Africa. Its vector is *Recilia mica* (Homoptera Jassidae) a type of leafhopper that lives mainly on grasses. The symptoms are damp rot at the base of the spear, yellowing at the base of young leaves, wet rot of the root cortex and orange-brown discoloration (CIRAD, 2008).

(D) Pests of Oil Palm:

Common pests of oil palm seedlings include mites, spider, grasshopper, locusts, termites, aphids, spear borer, rodents, bats and weaver birds. Mite is a tiny eight-legged invertebrate animal related to spiders and ticks. Some transmit disease and attack oil palm seedlings. Spider uses its cob-web to curl the leaves of oil palm seedlings, thus hindering growth and development of the affected palms. Insects like locusts, termites and grasshopper etc. eat up the leaves of growing seedlings thus retarding their growth and development. Rodents uproot the planted seed or growing palm from the ground, examples of rodents are rat, rabbit grass-cutter etc.

4.5 Other Problems that Affects Nursery Production

CIRAD, 2008 reports that the following problems could affect oil palm seedlings at the pre-nursery stage. *Seedlings fail to develop* **-** this may be due to poor quality substrate, inadequate soil disinfection, poor planting, over- or under-watering or pest attack. *Foliage appears scorched* **-** the causes may be inadequate watering after fertilizer applications, application rate errors, wrong choice of product when applying pesticides, or too sudden a removal of shade. *Foliage turns yellow* **-** this is often the result of insufficient shade, nitrogen deficiency beyond the third month, or too much water. *Brown necrosis at leaf tips* - this can occur if there is too much shade. *Inadequate information and nursery production knowledge* could lead to improper planning and selection of inappropriate site for nursery production. Lack of knowledge on the application of improved agronomic practices such as planting, weeding, watering, mulching, pruning, culling, pest and disease control could drastically reduce the profitability of oil palm nursery. Insufficient watering could cause blast leading to death of central spear.

4.6 Management of Risk and Uncertainty in Nursery

Risk management involves choosing among alternatives to reduce the effects of the various types of risk. It typically requires the evaluation of tradeoffs between changes in risk, changes in expected returns, entrepreneurial freedom, and other variables. Understanding risk is a starting point to help producers make good management decision in situation where adversity and loss are possibilities (Harwood, *et. al.,* 1999). Risk management is the system of measures by individuals and organizations that contribute to reducing, controlling and regulating risks (OECD, 2009). There are two main rationales for a government role in agricultural risk management. First, if risk markets are not efficient government action may be Pareto improving. The second rationale relates to equity or redistribution: societies may express a social preference to assist those suffering some types of loss (OECD, 2009). Risk and uncertainty management in nursery requires the application improved nursery practices in the production of oil palm seedlings. Some of such practices are discussed below.

4.7 Reducing Risk through careful Site Selection:

Preferably, the nursery should be located on a level, well-drained area close to the centre of future plantation and accessible road particularly in the case of commercial nursery. It is essential to have an uninterrupted supply of clean water and top-soil, which is both well-sructured and sufficiently deep enough to accommodate three rounds of on-site bag-filling (Mutert, et. al. 1999; CIRAD, 2008).

4.8 Reducing Risk through Proper Handling of Germinated Seeds

CIRAD (2008) recommends that seeds should be transferred to the pre-nursery immediately on arrival. However, if they have to be stored for short period (2 – 3 days), it is not necessary to open the bags before transfer. The bags of seeds with the original pack should be placed on the shelves in a dark room at ambient temperature. For preservation beyond 2-3 days, rapid aeration and very light misting with a small hand sprayer (if the bag walls are dry) may be needed, thereafter carefully re-close the bags. In principle, the maximum storage period should not exceed one week. If seed development is insufficient for transfer to the pre-nursery (plumule and radicle should reach 8-15 mm), store them in their original packaging for a few days, and up to 2 weeks if necessary, in the shade at ambient temperature. The bags should show traces of humidity but excess moisture should be avoided. Slight spraying or drying might prove necessary (CIRAD, 2008).

4.9 Reducing Risk through Improved Oil Palm Nursery Management

Nursery could be single or double stage. However, double stage nurseries, compared to a single stage nursery, are preferred because they require less space and irrigation, and allow for more efficient upkeep and selection (culling). However, the double stage nursery involves transplanting pre-nursery seedlings to the main nursery, which if done improperly, may cause transplanting shock. Each nursery should have lockable stores for parts, tools and equipment and for chemicals and fertilizers (near a water supply). Herbicides must be clearly marked and kept separately from insecticides, fungicides, and foliar fertilizers to prevent contamination and incorrect handling (Mutert, *et. al* 1999). Mutert, et. al. (1999) suggest as discussed below on nursery management. Prenursery beds 10 m in length x 1.2 m in width hold 1,000 seedlings (100 x 10) planted in 250 gauge, black UV stabilized, 15 cm x 23 cm polybags. Two rows of drainage holes are punched in the bags. Using the best available hygienic soil, and after sieving it through a 5 mm metal screen and amending it with phosphorus (P) fertilizer, bags should be filled to within 2 cm of the rim. The fertilizer should be mixed thoroughly with the soil to provide optimum P availability to the seedling's root system. If quality topsoil is used, no further manuring is required in the prenursery. The filled poly-bags must be prepared four weeks before the seed arrives and should be watered daily until planting to ensure adequate P availability. CIRAD (2008) recommends that a hole 2-3 cm deep is made in the middle of each bag, the seed is placed at the bottom of the hole with radicle pointing downwards, plumule pointing upwards and is covered with soil to a maximum depth of 1 cm as shown in Fig. 9. Poorly-developed, diseased, broken or twisted seeds should not be planted. Only normally germinated seeds with well differentiated plumules and radicles should be transferred to a prenursery. Transplanting the seedlings is a delicate job and should be carried out by experienced staff (CIRAD, 2008).

Prenursery seedlings must be watered daily, whenever rainfall is less than 10 mm per day, irrigation is required, and the system must be capable of uniformly applying 6.5 mm water per day (Mutert, *et. al.* 1999). Prenursery shading helps emergence and protect seedlings from dehydration, but this is gradually reduced after two months to subject the prenursery seedlings to hardening (gradual adjustment to full sunlight) before transplanting to main nursery. Prenursery seedlings in the four-leaf stage of development are transplanted to the main nursery after 3 months with careful selection process. Prenursery seedlings with abnormal characteristics such as grassy, crinkled, twisted or rolled leaves should be discarded. In case of doubt, the seedling should be removed (Mutert, *et. al*. 2008). After transplanting, watering is done regularly with adequate supply of clean water. Improved agronomic practices including weed control, mulching, fertilizer application, pruning, culling, pest and disease control must be done with the instruction and supervision of experts to ensure adequate nursery management as well as possible risk reduction. Seedlings spent 9-12 months in the main nursery before they are transplanted to the field after careful selection and culling of diseased and doubtful palms. Only healthy and vigorous palms should be planted in the field.

4.10 Reducing Risk through Strategic Risk Management:

Harwood, *et. al*. (1999) report risk management strategies of farmers as follows; enterprise diversification, vertical integration, production contracts, marketing contracts, hedging in future, future options contracts, maintaining financial reserves and leveraging, liquidity, leasing input, insuring crop yields and crop revenues. However, USDA survey in 1996 found that keeping cash on hand was the number one risk management strategy among farmers. Risk-sharing e.g. share-cropping system, risk-pooling e.g. insurance and diversification are generic measures of risk reduction. The two main market tools to manage risk in agriculture are future markets to deal with price risk and insurance markets to deal mainly with production risk (OECD, 2009). The market outcome may not be Pareto optimal and in most cases the economy does not provides the correct set of markets (OECD, 2009). Therefore, it is expedient for government to establish or develop the basis for the creation of new risk related markets. Given the existing markets, are resources efficiently allocated? If not, there may be some role for government improving welfare.

5.0 Conclusion

Palm oil accounts for 34% and 63% of the world's annual production and exports of vegetable oils respectively. It is produced in 42 countries and Nigeria is the fourth largest producer in the world (IPPA, 2010). The industry provides direct and indirect employment to about four million people in twenty-four oil palm growing states in Nigeria and beyond. The study used primary and secondary data. Tobit regression model was used for analysis and the results show that the major determinants of risk and uncertainty in oil palm nursery were cost of sprouted seeds, lack of financial capital, high incidence of pests and seed adulteration. Therefore, it is recommended that management of risk and uncertainty in oil palm nursery should involve purchasing seed from the right source, pest and disease control, ample provision of financial capital and complete subsidization of sprouted seed costs. Others are careful site selection, proper handling of germinated seeds and application of improved agronomic practices in the management of nursery. In addition, the use of risk management strategies should not be disdained.

References

Ahmed, S. A. (2001): Agriculture and Food Security in Nigeria. Paper prepared for a forum with Mr President on Agriculture and food security council chambers presidential Villa, Abuja, Nigeria.

American Oil Chemists' Society, (2012): Palm Oil in the Market. James Hutton Institute, (and Mylnefield Lipid Analysis). http://lipidlibraryaocs.org/authors/cv_fdgunstone.htm, Scotland.

Badmus, G. A.; Adeyemi, N. A. and Ikheloa, M. (2005): The Oil Palm as a Sustainable Resource for Nigeria's Economic Empowerment and Development Strategy. Presented at the 6th International Conference of the Nigerian Institution of Agricultural Engineers at the Family Support Program (FSP) Multipurpose Hall, Yenogoa, Bayelsa State, 14-18 November, 2005.

Bodie, Z. and Merton, R. C., (1998): *Finance*. Upper Saddle River, NJ: Prentice Hall. In: Harwood, J.; Heifner, R.; Coble, K.; Perry, J. and Somwaru, A. (1999): Managing Risk in Farming: Concepts, Research, and Analysis. Market and Trade Economics Division and Resource Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 774.

Central Bank of Nigeria, (2012): Central Bank of Nigeria Annual Report 2012.

Chapman, C., Ward, S. (2002): Constructively simple estimating: a project management example, Journal of the Operational Research Society, Vol. 54, No. 10, 1050-1058. In: Migilinskas, D. and Ustinovičius, L. (2008), Methodology of risk and uncertainty management in construction's technological and economical problems.

CIRAD (2008): Germinated Oil Palm seeds; Recommendations for Pre-nursery and Nursery Management. Email: oilpalmseeds@cirad.fr www.oilpalmseeds.com France.

Corley, R. H. V. and Tinker, P. B. (2007): The oil palm (Elaesis guineensis jacq). World Agriculture Series. Fourth Edition, Blackwell Science Ltd. Oxford, United Kingdom.

Darby, S. (2009): Palm Oil Industry in Malaysia.Skills & Knowledge for Sustained Development in Africa.

Federal Ministry of Agriculture and Rural Development (2011): Agricultural Transformation Agenda: We will Grow Nigeria's Agricultural Sector. Abuja, Nigeria.

Harwood, J.; Heifner, R.; Coble, K.; Perry, J. and Somwaru, A.(1999): Managing Risk in Farming: Concepts, Research, and Analysis. Market and Trade Economics Division and Resource Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 774.

Heijden, K. S., (1996): The Art of Strategic Conversation, John Wiley & Sons, UK,
HMSO, (2004): The Orange Book, Management of Risk - Principles and Concepts. HM Treasury. Crown copyright. licensing@cabinet-office.x.gsi.gov.uk, www.hm-treasury.gov.uk ISBN 0-471-96639-8
Initiative for Public Policy Analysis (2010): African Case Study: Palm Oil and Economic Development in Nigeria and Ghana; Recommendations for the World Bank's 2010 Palm oil Strategy. Initiative for Public Policy Analysis (IPPA), Lagos, Nigeria. Email: info@ippanigeria.org www.ippanigeria.org
Migilinskas, D. and Ustinovičius, L. (2008), Methodology of risk and uncertainty management in construction's technological and economical problems. The 25th International Symposium on Automation and Robotics in Construction (ISARC), Institute of Internet and Intelligent Technologies, Vilnius Gediminas Technical University.
Mutert, E.; Esquivez, A. S.; de los Santos, A. O. and Cervantes, E. O. (1999): The oil palm nursery: Foundation for high production. Better Crops International. Vol. 13, No.1, May. Mexico.
Newbery, D.M. and Stiglitz, J. (1981), *The Theory of Commodity Prices Stabilization*, Oxford University Press. In: OECD, 2009 An overview of policy measures for Risk Management TAD/CA/APM/WP/24 Final.
Nigerian Institute for Oil Palm Research NIFOR, (2002)$_{(a)}$: Public Notice, Sales of unimproved sprouted oil palm seeds and seedlings. Caveat Emptor. In The Nigerian Observer, Wednesday, September 18, 2002. p 16.
_______________________________, (2002)$_{(b)}$: Public Notice, Sales of unimproved sprouted oil palm seeds and seedlings.Caveat Emptor. In The Guardian, Thursday, September 19, 2002. p 24.
OECD, (2009): An overview of policy measures for Risk Management TAD/CA/APM/WP/24/Final. In: Managing Risk in Agriculture: A Holistic Approach (*Extracts)*-OECD, 2009.
——,(2000): *Income Risk Management in Agriculture*, OECD Paris. In: Managing Risk in Agriculture: A Holistic Approach (*Extracts)* - OECD, 2009.
Okiy, D. A.; Nwawe, C. N.; and Ikheloa M. (2006): Oil Palm and the Nigerian Economy. *Proceedings of the 40th Conference of the Agricultural Society of Nigeria, Abia 2006.*
Okwuagwu, C. O. (1997): The Development of NIFOR, High Yielding and Stable Extension Work Seed (EWS) and the Consequenses of Adulteration of Oil-Palm Planting Materials. Presented on the Occasion of the 26th Jan. 1997 Meeting of NIFOR with Major Oil palm Growers of the Country. Held at NIFOR Main Station, Benin City, Nigeria.
Olayemi, J. K. (2004): Principles on Microeconomics for applied Economics Analysis. SICO Publishers, Mokola, Ibadan, Nigeria.
Omoti, U. (2011): The Nigerian Oil Palm Industry: Past Performances and Current Challenges. Invited Paper presented at the Workshop on Tapping into Opportunities in the Oil Palm Sector of Nigeria's Economy organised by FCMB Plc, Benin City, Nigeria, 24-25th October.
_________, (1999): Towards Rehabilitating and Revitalizing the Nigerian Oil Palm Industry, Paper presented at the P.T.F. Consultative Forum on Rehabilitation of Oil Palm and Coconut in the Country, Benin City, Nigeria.
Samset, K. (1998): Project management in a high-uncertainty situation. Uncertainty, risk and project management in international development projects, Ph.D. Dissertation, Norwegian University of Science and Technology
Soy Stats (2012): The American Soybean Association.
Strand, R., and Oughton, D., (2009): Risk and Uncertainty as a Research Ethics Challenge, National Committees for Research Ethics in Norway. http://www.etikkom.no
Tobin, J. (1958), "Estimation of Relationship for Limited Dependent Variables," Econometrica 26' p24-36.
Torp, O., Kilde, H.S., (1996) "Usikkerhet som styringsparameter ved prosjektgjennomføring", NTNU, Trondheim, Norway. ISBN 82-7706-061-0. In: Samset, K. (1998): Project management in a high-uncertainty situation. Ph.D. Dissertation, Norwegian University of Science and Technology
USDA, (2012). United States Department of Agriculture.
www.fao.org/worldfoodsituation/FoodPricesIndex. In: Rosillo-Calle, F., Pelkmans, L., & Walter, A. (2009). A Global Overview of Vegetable Oils, with Reference to Biodiesel. A report for the IEA Bioenergy Task 40. Vito vision on technology. UNICAMP. Imperial College, London.
www.fas.usda.gov/psdonline. In: Rosillo-Calle, F., Pelkmans, L., & Walter, A. (2009). A Global Overview of Vegetable Oils, with Reference to Biodiesel. A report for the IEA Bioenergy Task 40. Vito vision on technology. UNICAMP. Imperial College, London.
Wynn, B., (1992): Science and Social Responsibility in J. Ansell and F. Wharton (eds.), Risk: Analysis, Assessment and Management, Wiley & Sons, New York, 137-152