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An Economic Evaluation of Investment in *Mucuna solannie* Production

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***Abstract*— *Mucuna solannie, a perennial crop, is a Fabaceae found in the South East of Nigeria and in some African and Asian countries. It exhibits interesting properties as a food additive, where it serves as viscosifier. It has, hence, been tested and used to formulate a drilling mud. The drilling mud formulated from it compares quite fine with other muds; with excellent rheological properties. It is suitable for top hole sections. The purpose of Mucuna solannie farming, as a cash crop, is to maintain adequate supply for continued application in the drilling industry; hence, it is a business venture. Also, a comprehensive list of processing equipment has been provided. The study gives the first pass assessments of the requirements for production and processing, necessary for sustained supply. A suitable farm location has been found in South-East Nigeria. Square planting pattern, on 10 hectares area of land, based on one plant per hill, with no filler crops, has been shown to yield 63.9 metric tonnes per year. An initial minimum investment of about $820,920 is required for seeds, land rent, equipment costs and other contingencies; with projected minimum revenue of $283,500 per year, at 22% DCF ROR, if the venture must remain profitable.*

Keywords*— *Mucuna solannie, Cash Crop, Discounted Cash Flow Rate of Return, Spider Diagram.

I. INTRODUCTION

Additives are substances added to the mud to enable it achieve the functions. They are grouped under viscosifiers, densifiers, filtration control agents etc. Generally, there are more than 3000 additive products as published by *World Oil* once in a year. The viscosifiers control the rheological property to help carry cuttings to the surface and suspend cuttings at slow circulation rate or when pumps are off to prevent barite sag and cuttings settling at the bottom.

The feasible means of reducing cost is by the use of alternatives that could be sought locally from the area where drilling is performed, and which could also be exported to enable drilling to be performed inexpensively in other locations. These alternatives must satisfy the standard API and OCMA requirements of correct standards in terms of their properties, safety and environmental friendliness. For instance, the local food thickener *Mucuna solannie* in addition to being edible is degradable.

The local food additive is a good candidate for such based on its performance as an agent used in cooking and other culinary activities. In other words, it exhibits properties similar to the ones currently being applied in the drilling industry. It has been used to formulate water based which exhibited properties comparable with conventional muds, and served as a cost reducing agent in the mud (N. Uwaezuoke, PhD Dissertation, 2016)

The need for alternatives to reduce cost of drilling and hence encourage local manufacturers, which has been the government of Nigeria's target since independence, would have been realized in this area after the study and successful deployment of the results and lessons learnt from it. The aim of this work is to provide a background for investment in the production and processing *of Mucuna solannie.* The results from the research would contribute to knowledge about the requirements for the crop production and processing, hence encouraging the agricultural produce export pursuit of the Federal Government of Nigeria. Most of the factors that may affect the marketability, profitability or sustainability of the undertaking are considered.

II. LITERATURE REVIEW

2.1 Characterization of Mucuna solannie

Based on archeological records, farming or agriculture started at least 10,000 years ago. Over the years, there has been a gradual shift from the reliance on the traditional 2Cs (coffee and cotton) and 2Ts (tea and tobacco) towards the new money making crops like vanilla, sesame, maize and others. *Mucuna* is a genus of around one hundred accepted species of climbing vines and shrubs of the family fabaceae, found worldwide in the woodlands of tropical areas (Obiakor-Okeke, P.N. *et al*, 2014) in several ountries of Asia and Africa. The leaves are 3-palmate, alternate or spiraled, and the flowers are pea-like but larger, with

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distinctive curved petals, and occurring in racemes. Like other legumes, *Mucuna* plants bear pods. They are generally bat-pollinated and produce seeds that are buoyant sea-beans. These have a characteristic three-layered appearance, appearing like the eyes of a large mammal in some species and like a hamburger in others (most notably *Mucuna solannie*) and giving rise to common names like deer-eye beans, ox-eye beans or hamburger seed (Wikipedia). Mucuna plants bear pods, and the seed pods are protected by velvety hairs. Pods are produced on long, rope-like stems that hang from the forest canopy. At maturity, each pod produces several hard, marble like seeds.

Mucuna seeds are toasted before grinding and flouring to serve as thickener in soup or sauce. The Igbo of South-East Nigeria use it as part of main dish as thickener for soup, beverages and other food items (Afolabi, O.A. *et al* 1985, Ukachukwu, S.N. *et al*, 2002). *Mucuna solannie* consists of high protein, high carbohydrates, low lipids, high fibre, adequate minerals, and meet the requirement of essential amino acids (Table 2.1).

It belongs to the family Fabaceae (formerly leguminosae), as well as the sub-family Caesalpinioideae (Nwosu, J.N., 2012). For the purpose of this work, the botanical name *"Mucuna solannie"* has been used since there are varieties of species of the sample, and irrespective of the fact that they have different names given to them by different villages in their areas of use as local food additives (Figure 2.1). Equally, locally, it is known as 'Ukpo' by the Igbos, 'Yerepe' by the Yorubas and 'Karasau' by the Hausas (Onudibia, M.E., *et al*, 2014). *Mucuna solannie* can be attacked by micro-organisms when hydrated (fermentation) unless protected by high pH, high salinity or a biocide. The species of *Mucuna solannie* include *Mucuna urensi*, *Mucuna pruries*, *Mucuna sloanei* and *Mucuna Veracruz*.

Fig.2.1: Mucuna solannie as seen after harvest

It grows in clayey-sandy soil with normal rainfall in the South-East, but production of the seeds start with flowering between April and May, and fruits between September and January (Onudibia, M.E. *et al*., 2014). Each stand produces at least 200-300 seeds per year.

Table.2.1: Proximate Chemical Analysis of Mucuna solannie seeds (Obiakor-Okeke, P.N. et al, 2014)

	Raw (dehulled)	Cooked
Moisture (%)	10.5 ± 0.20	12.0 ± 0.2
Protein (%)	24.0 ± 0.11	19.6 ± 0.38
Fat (%)	6.5 ± 0.26	8.3 ± 0.21
Fibre (%)	3.8 ± 0.21	5.3 ± 0.35
Ash (%)	3.3 ± 0.26	3.0 ± 0.26
Carbohydrate (%)	54.4 ± 0.26	62.3 ± 0.40

In farming activities, cost of production represents the dollar value of all the inputs for growing a specific crop. The inputs would include so many units of seed, fertilizer, irrigation water, labour and machinery. Since each of these units has a dollar value, they are added up and used to determine the cost of production/processing for the crop. Estimating cost could be easy in some instances and more difficult in others. Assigning costs (revenues) is more straightforward. Determining the production costs is a prerequisite for knowing how well a farm business is doing in order to predict how the business will respond to specific changes, evaluation of how efficiently resources are being used in the farm and to make other useful decisions. When two or more mutually exclusive alternatives are evaluated, engineering economy can identify the one alternative that is the best economically (Leland, B. *et al*, 2002)

2.2 Economic Evaluation Principles

Economic evaluations of alternatives require cash flow estimates over a time period and a criterion for selecting the best alternative. The nature and type of alternatives must be recognized before starting any economic evaluation. Alternatives are either revenue-based or service-based as determined by cash flows. In revenue based alternatives, each alternative generates cost and revenue cash flow estimates, while in service based alternatives, each alternative has only cost cash flow estimates. Alternatives are selected by the use of evaluation tools such as Net Present Value (NPV) and Discounted Cash Flow Rate of Return (DCF-ROR).

2.2.1 Net Present Value

The Net Present Value is used to evaluate one alternative or two and more alternatives. For single alternative cases, once

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the Net Present Value at the Minimum Acceptable Rate of Return in an investment is greater than or equal to zero, the Minimum Acceptable Rate of Return is met or exceeded and the alternative is viable.

If two or more alternatives are considered, the Net Present Value at the Minimum Acceptable Rate of Return is calculated and compared. The alternative with the numerically largest Net Present Value is selected. For all negative NPV's, the least negative is selected, while for all positive NPV's, the most positive is selected. For both negative and positive NPV's, the more positive alternative is selected. The Net Present Value tool can also apply in incremental analyses cases.

The *NPV function* in Microsoft Excel can be used to accomplish NPV calculations.

2.2.2 Discounted Cash Flow Rate of Return

This is the bank rate-of-interest that is made on an investment in a project. Once a Minimum Acceptable Rate of Return is stated, this evaluation tool is also used on one alternative or to select between two or more alternatives. The DCF-ROR is the interest rate that returns the NPV to zero. In other words, if the DCF-ROR is determined and applied on the cash flow series, the Net Present Value should be $0.00.

It is also applied in incremental analysis on two alternatives to check it the extra investment is worthwhile. If the DCF-ROR available through the incremental cash flow equals or exceeds the Minimum Acceptable Rate of Return, the alternative associated with the extra investment should be selected (Leland Blank, *et al*, 2002), otherwise reject it. For more than two alternatives, it can be used as a screening tool to eliminate all alternatives that have DCF-ROR less than the Minimum Acceptable Rate of Return.

Similarly, the *IRR function* in Microsoft Excel can be used to accomplish DCF-ROR calculations.

2.2.3 Salvage (residue) Value

Salvage (residual) value is one of the constituents of a leasing operation that describes the future value of a good in terms of percentage of depreciation of its initial value. It is the remaining value of an asset after it has been fully depreciated. It is given as a percentage of the initial value of the item, and calculated after the item's useful life. The life of an asset is given in contract terms.

2.2.4 Unequal-lives Alternatives Comparison

When two or more alternatives with or without salvage values are considered, some of the alternatives might have different useful lives. Since incremental rate of return requires equal-service comparison, the lowest common multiple (LCM) of lives must be used to determine the years in the cashflow series. For example, for two alternatives A and B with 5 years and 10 years' service lives respectively, the LCM is 10 years. Hence, the incremental cash flow tabulation for 10 years must be used and reinvestment and salvage values must be shown in years 5 and 10.

III. METHODOLOGY

Cash crop farming or commercial farming or cash cropping is for profit, developed using the mono-cropping or sole cropping system, as against subsistence farming. Commonly, cash crop farming is practiced by growing cash crops in plantation scale. Advantages include source of living for the farmer, salaries and wages for the employees and farm workers, and government revenue through taxes. In this work, costs of weed control, pest control and fertilizer are not given since the crop, so far, have a lot of information lacking on the best practices for its commercial production; such as the type of fertilizer suitable for it and no known pests that attack it. Cost of machineries is not considered as planting is done by hand hoe/farm implements. Creating a farm budget involves tools, such as, paper and pencil, computer and spreadsheets, and information (research). The parameters involved in the first steps include acreage, income goals and markets (Hendrickson, J., 2014).

3.1 Plant Population densities

In square planting, one plant or a group of plants in a common hill occupies the corners of a square which has 4 sides of equal lengths. A 10 m x 10 m spacing in square planting will result to a crop area having 10 rows and 10 cross-rows that are both 10 meters apart and perpendicular to each other. Diagonally, the plants also form rows that are about 7.1 meters apart.

The rectangular arrangement is similar to a square pattern except that a rectangle has two sets of opposite sides having different lengths. A rectangular planting with 10 m x 12 m will mean that two adjacent rows will be 12 meters apart and plants within each row will be spaced 10 m apart; perpendicular to these rows are cross-rows that are spaced 10 m with plants that are 12 m apart. When the plant-to-plant distance within the row is 1/3 to 1/2 of the distance between rows, the planting pattern is usually called hedgerow**.**

The quincunx **or** diamond pattern of arranging row-planted crops is a modified form of the square pattern. It consists of a square that is formed by 4 closest plants with an additional plant at the center of these 4 plants. The 4 plants that form a square are the main crops while the hill at the center is intended for another crop or variety and called a filler crop.

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By connecting with imaginary lines 4 closest hills that include 2 main hills and 2 filler hills, the shape that is formed is a diamond (Ben, G.B., 2011).
Based on 10 hectares (100,000 sq. m) of land, a square planting pattern is recommended. One plant occupies the corners of the square which has four sides of equal length (Figure 3.1). There shall be no filler crops that occupy the center of every square. The population density for the 10-hectare-model is then determined using the formula;

$$PD = \left[\frac{A}{d_1 - d_2}\right] * NPh \qquad 3.1$$

Where,
PD = population density of plants per hectare, i.e. number of plants per sq. m.
A = farm area, sq. m.
d_1 = distance between rows, m
d_2 = distance between hills within the rows, m
NPh = number of plants per hill

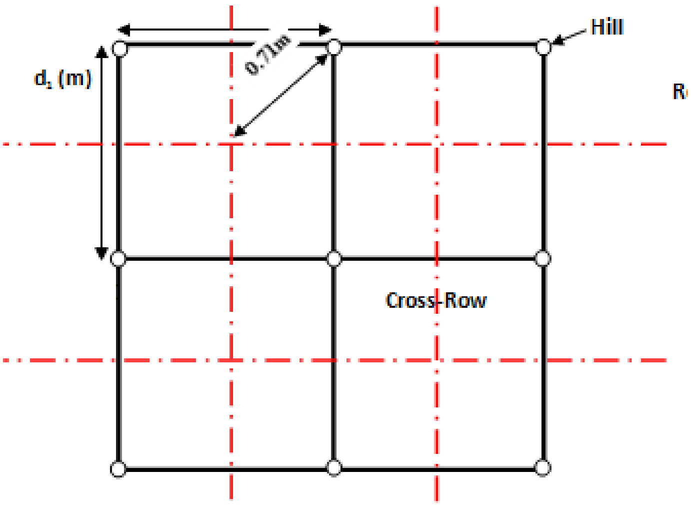

Fig.3.1: Square planting Pattern


Fig.3.2: An idealized farming pattern

Hence, for 10-hectares of land (100,000 sq. m), where individual crops are arranged in 1m x 1m square planting, with one plant per hill, the population density (PD) is 100,000 plants. This is equivalent to 10,000 plants per hectare. Two or three plants per hill are also possible. Some form of staking might be required when the plants begin to flower.

3.2 Projected Plant Yield/Production per Annum

Assumptions:

- Cost of seed for planting, 50 cents per seed.
- Average weight of seeds is 3g per seed for dehulled/processed seeds.
- Average yield of plant is 213 seeds/plant per year.
- One plant per hill.

Therefore;
100,000 plants (in 10 hectares) = 100,000 plants * 213 seeds per year = 21, 3000,000 seeds per year.
3g per seed = 21,300,000 seeds per year * 3 g per seed = 63,900,000 g per year = 63,900 kg per year = **63.9 metric tonnes per year**. Subsequently, two plants per hill would give 127.8 metric tonnes per year, for the same plant yield etc.
Initial cost of seeds/plants;
US $0.5 per seed (plant) * 100,000 plants = US $50,000, based on one plant per hill.

3.3 Processing Equipment

Tables 3.1 to Table 3.8 are the cash flow estimates for alternative equipment and assets required for production and processing of *Mucuna solannie* up to the final stage. The materials include costs of grinding machines, seeds drying equipment, trucks, dehulling machines, sources of water supply, dry powder storage tanks, labeling machines,

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packaging machine, alternative locations of the farmland and other miscellaneous expenses. It is assumed that the processing facility will be cited close to the farm. Cash flow series for the different items were developed by considering the salvage values and lives of the alternatives, and the economic decision tools (NPV and DCF-ROR) were applied in selection of the alternatives. Whereas equipment and sources of water are analyzed based on alternatives available, investing in a farmland requires comparison between sale and rental prices (Table 3.8), because land is not a homogeneous commodity.

Table.3.1: Cost estimates of alternative types of grinding machines

	Locally Fabricated (A)	Imported (B)
Initial cost,$	(1500)	(4200)
Operating costs,$	(250)	(210)
Salvage value,%	5	15
Life, years	5	10

Table.3.2: Cost estimates of alternative types of seeds drying equipment

	Locally Fabricated (A)	Imported(B)
Initial cost,$	(7000)	(8000)
Operating costs,$	(250)	(150)
Salvage/Residual value,%	None	5
Life, years	5	10

Table.3.3: Cost estimates of alternative brands of trucks

	Foreign Used (A)	Locally Used (B)	Brand New (C)
Initial cost,$	(16500)	(22500)	(38500)
Annual costs,$	(4300)	(5900)	(3120)
Salvage/Residual value,%	None	None	16
Estimated Competitive Life, years	10	5	10

Table.3.4: Cost estimates of alternative types of dehullers

	Locally Fabricated (A)	Imported (B)
Initial cost,$	(1500)	(4200)
Annual operating costs,$	(120)	(100)
Salvage/Residual value,%	5	10
Life, years	5	10

Table.3.5: Cost estimates of alternative sources of water

	Tanker Supply (A)	Sink Borehole (B)	Buy Locally Fabricated tanker (C)	Buy New Tanker (D)
Initial cost,$	0	(4000)	(22500)	(48000)
Annual costs/revenues,$	(4800)	4800	1800	3000
Salvage/Residual value,%	None	None	30	60
Life, years	10	10	10	10

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Table.3.6: Cost estimates of alternative types of dry powder storage tanks

	Imported (A)	**Locally Fabricated (B)**
Initial cost,$	(8000)	(15000)
Operating costs/Labour,$	(14400)	(12000)
Salvage/Residual value,%	None	None
Life, years	10	10

Table.3.7: Cost estimates of alternative types of paper and plastic bags labeling machines

	Locally Fabricated (A)	**Imported (B)**
Initial cost,$	(1450)	(7875)
Operating costs/Revenue,$	(78)	600
Salvage/Residual value,%	None	6
Life, years	10	10

Table.3.8: Alternative site locations based on choices to use either 'Purchased' or 'Leased' land

Land Size	**10 Hectares (10X Size of Football Field)**		
ALTERNATIVE #1	Land Purchase		
Locations	Jigawa State (A)	Enugu State (B)	Rivers State (C)
Initial cost,$	(325000)	(650000)	(800000)
Annual costs/revenues,$	(45000)	(21000)	(20000)
Life, years	10	10	10
ALTERNATIVE #2	Land Lease		
Locations	Jigawa State (A)	Enugu State (B)	Rivers State (C)
Initial cost,$	(325000)	(400000)	(500000)
Annual costs/revenues,$	(45000)	(21000)	(20000)
Life, years	10	10	10
Final Location Selection	ALTERNATIVE #1 vs ALTERNATIVE #2		
Locations	Jigawa State (A)	Enugu State (B)	
Initial cost,$	(325000)	(400000)	
Annual costs/revenues,$	(45000)	(21000)	
Life, years	10	10	

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IV. RESULTS AND DISCUSSION

The population density of 10,000 plants per hectare in square planting pattern is recommended for *Mucuna solannie* farming, with no filler crops. That would yield about 63.9 metric tons per year, based on one plant per hill. It is based on growing the material on 10 hectares of land, leased in a community in Enugu State the South-Eastern Igbo speaking part of Nigeria where the *Mucuna solannie* specie has been observed to grow productively as determined with economic evaluation tools. A list of alternatives chosen is presented in Table 4.1, and the expenditure cash flow breakdown shown in Table 4.2. It was developed from market survey and complete analyses where alternatives were considered and choices made based on Net Present Value, Discounted Cash Flow Rate of Return or combination of both.

Table.4.1: List of Alternatives and other considerations after Engineering Analyses

S/N	Description	Type/Features	Cost ($)
1	Grinding Machine	Local	1,500
2	Seeds Dryer	Imported	8,000
3	Project Vehicle	Foreign Used Hilux	16,500
4	Generator	MARAPCO (500KW/625 KVA, Diesel)	50,000
5	Seeds Dehuller	Local	1,500
6	Water Supply	Borehole	4,000
7	Dry Powder Storage Tank	Local	15,000
8	Labelling Machine	Local (Paper and Plastic bags)	1,450
9	Land Location	Lease (10 Hectares) in Enugu State	400,000
10	Packaging Machine	Imported (Automatic Bagging, Weighing and Sewing), 25 Kg bags	70,000
11	Seeds	100,000 seeds/plants	50,000
12	Building (Warehouse)	Farm Location	45,000
13	Computer/phone/email/website	Accounting/Communication	2,150
14	Harvest Cart or Wagon	Harvest	14,000
15	Safety Materials	Gloves, Coats, Booths etc	5,000
		TOTAL	**684,100**
16	Contingencies	Miscellaneous (20% of Total)	**136,820**
		TOTAL INITIAL INVESTMENT	**820,920**

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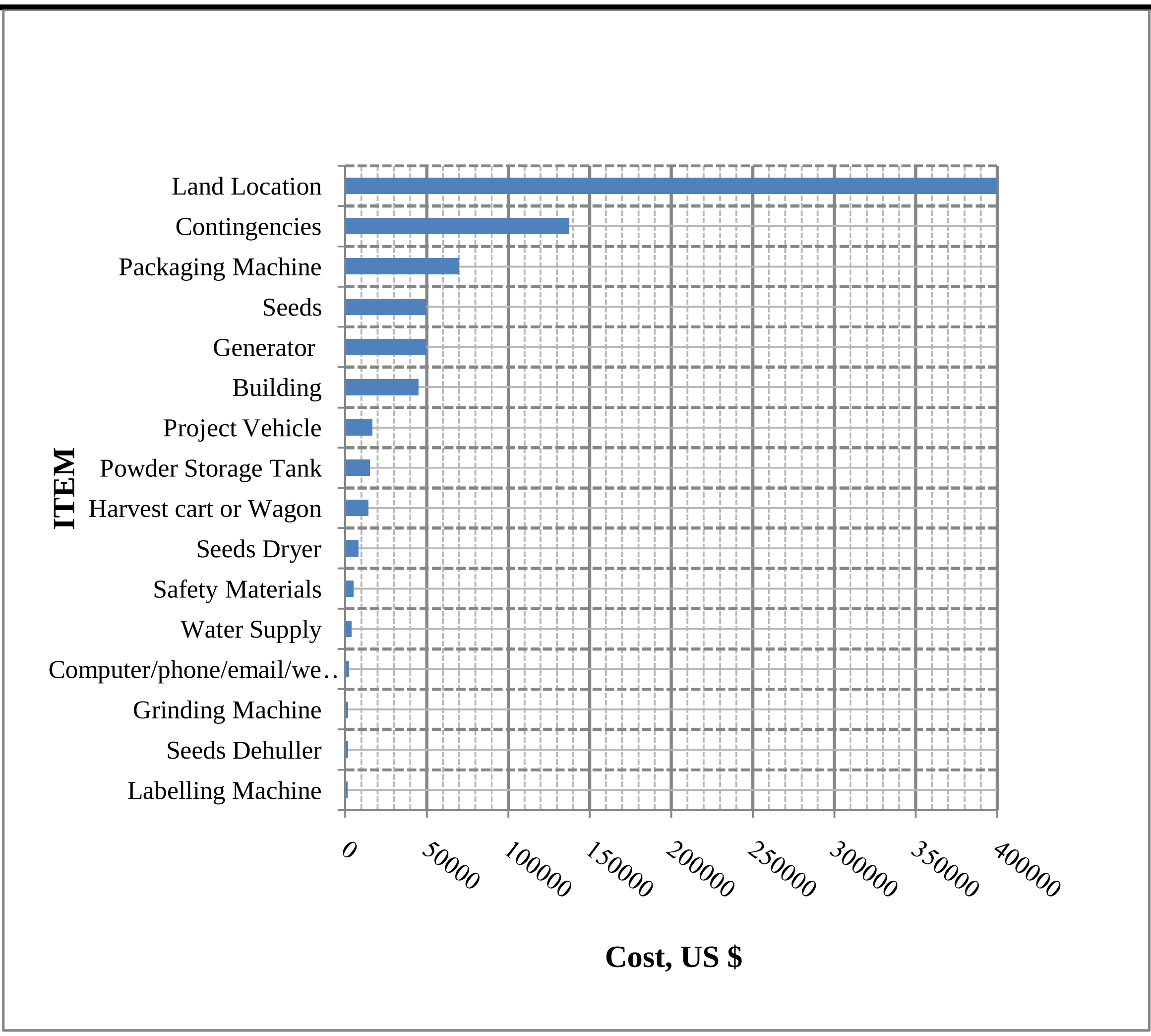

Fig.4.1: Costs of Items Selected from Alternatives

Table 4.3 shows the total initial investment required, the projected revenue, the net expenses (differences between costs and revenues) and the tax over 10-year duration.

Also, Table 4.3 looks at the effects of changes in our cashflow assumptions on expenses, investment and revenues. Expenses, investment and revenues are adjusted up and down by 50% to examine their effects. The final result is a spider plot (Figure 4.2), developed from Table 4.4.

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Table.4.2: Cashflow Base Case (showing expenditure breakdown) for Mucuna solannie processing

Yrs From Start	Rev	Inv	Exp Breakdown									Exp	Cash Flow
			Grinder	Dryer	Truck	Generator	Dehuller	Water Supply	Seed Powder storage	Labellling	Land Lease		
0	0	820.920										0	-820.920
1	250	0	-250	-150	-4300	-40000	-120	4800	-12000	-78	-21000	-73.098	176.902
2	250	0	-250	-150	-4300	-40000	-120	4800	-12000	-78	-21000	-73.098	176.902
3	250	0	-250	-150	-4300	-40000	-120	4800	-12000	-78	-21000	-73.098	176.902
4	250	0	-250	-150	-4300	-40000	-120	4800	-12000	-78	-21000	-73.098	176.902
5	250	0	-1675	-150	-4300	-40000	-1545	4800	-12000	-78	-21000	-75.948	174.052
6	250	0	-250	-150	-4300	-40000	-120	4800	-12000	-78	-21000	-73.098	176.902
7	250	0	-250	-150	-4300	-40000	-120	4800	-12000	-78	-21000	-73.098	176.902
8	250	0	-250	-150	-4300	-40000	-120	4800	-12000	-78	-21000	-73.098	176.902
9	250	0	-250	-150	-4300	-40000	-120	4800	-12000	-78	-21000	-73.098	176.902
10	250	0	-175	250	-4300	-40000	-45	4800	-12000	-78	-21000	-72.548	177.452
$1,000					N200/$, 63 ton Bases, $250,000/yr Expected Revenue							DCF-ROR	17%

=IRR (P6:P16)

Table.4.3: Base Case DCF-ROR for Variations in INV., EXP., and REV.

$M US					Base Case	INV +50%	INV -50%	EXP +50%	EXP -50%	REV +50%	REV -50%
Yrs From Start	Rev	Exp	Inv	Tax	NCR						
0	0	0.000	820.920	0	-820.920	-1231.38	-410.46	-820.92	-820.92	-820.92	-820.92
1	250	73.098	0	1	175.902	175.902	175.902	139.353	212.451	300.902	50.902
2	250	73.098	0	1	175.902	175.902	175.902	139.353	212.451	300.902	50.902
3	250	73.098	0	1	175.902	175.902	175.902	139.353	212.451	300.902	50.902
4	250	73.098	0	1	175.902	175.902	175.902	139.353	212.451	300.902	50.902
5	250	73.098	0	1	175.902	175.902	175.902	139.353	212.451	300.902	50.902
6	250	73.098	0	1	175.902	175.902	175.902	139.353	212.451	300.902	50.902
7	250	73.098	0	1	175.902	175.902	175.902	139.353	212.451	300.902	50.902
8	250	73.098	0	1	175.902	175.902	175.902	139.353	212.451	300.902	50.902
9	250	73.098	0	1	175.902	175.902	175.902	139.353	212.451	300.902	50.902
10	250	73.098	0	1	175.902	175.902	175.902	139.353	212.451	300.902	50.902
					938.100						
DCF-ROR					17%	7%	42%	11%	22%	35%	-8%

=IRR (H5:H15)

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Table.4.4: Summary of Base Case DCF-ROR for Variations in INV., EXP., and REV.

Up/Down 50%	DCF-ROR		
	Inv	Exp	Rev
50	7	11	35
0	17	17	17
-50	42	22	-8

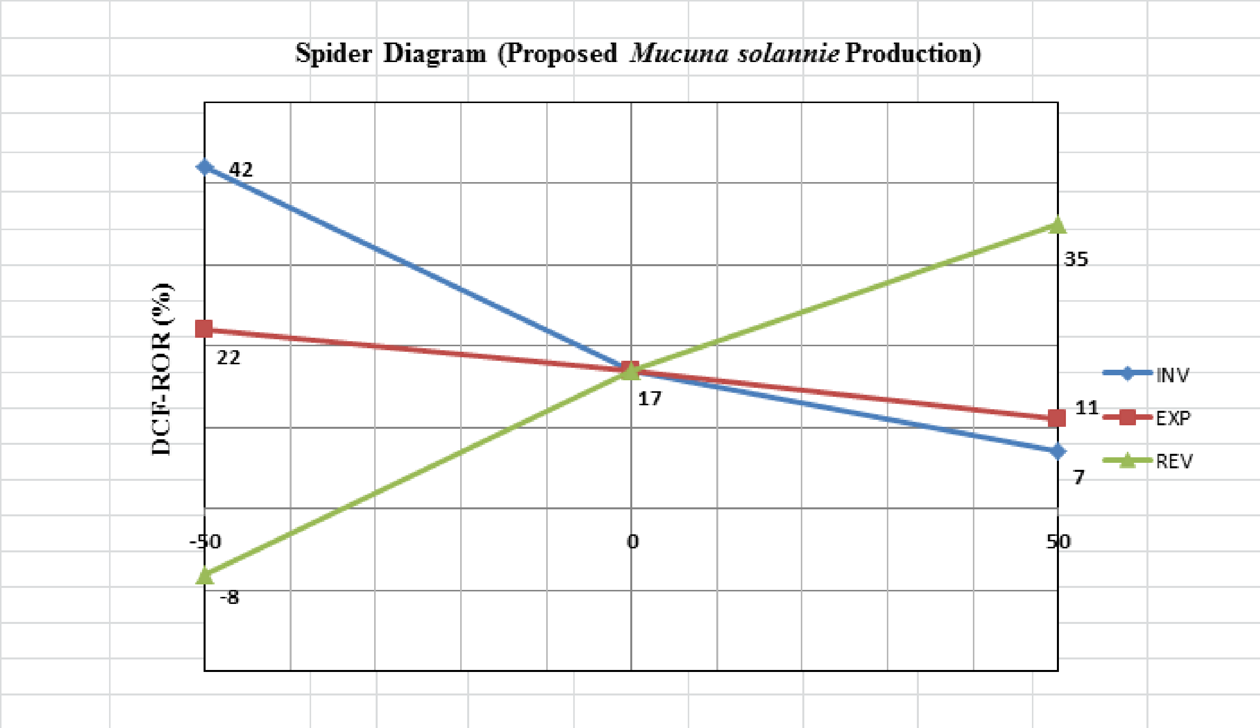

Fig.4.2: Spider Diagram for Venture into Mucuna solannie production

For the base case established in Table 4.2, the DCF-ROR is 17%. It is quite within the range of 12-20 % rate acceptable in most companies. If the investment is increased by 50%, the DCF-ROR is 7%, but if it reduces by 50% at the same projected revenue and expenses and maintaining the existing tax (applied in the table), the DCF-ROR is 42%.

Similarly, if the expenses are increased by 50%, the DCF-ROR is 11%, but if it is reduced by 50% the DCF-ROR is 22%. Also, if the revenue increases by 50%, the DCF-ROR is 35%, and if it is reduced by 50%, the DCF-ROR turns negative at -8%.

The NCR which is the cumulative cashflow = **$938,100**, the PAYOUT (the time taken for the cashflow to turn positive) is about **4.1 years**, the P/$ is the NCR/Initial investment, $938.100/$820.920 **= 1.1427**, the PV @ 22% **= $(130,820)**, and the DCF-ROR is **17%**.

For the agricultural venture into *Mucuna solannie* production to be successful, revenue should be sustained above a certain baseline based on initial investment. In this case, a minimum of **$283,500** per year is projected. Otherwise, it would take quite long for the investment to payout. This is not desirable where a farmland has been rented and loan taken from a bank.

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V. CONCLUSIONS

- Farmland rental is better than purchase for *Mucuna solannie* farming in the selected area based on economic analysis.
- Initial farming pattern, expected yield, and other advantages of *Mucuna solannie* cash crop farming that requires about $820,920 as initial investment have been presented. Increasing the projected revenue and/or increasing the plants per hill will reduce the breakeven time. Minimum revenue of **$283,500** per year is projected. Based on one plant per hill, the production of 63.9 tonnes per year is expected.
- Two or more plants per hill would increase the tonnes per year, but might reduce the yield due to competition. The range of 1 to 5 plants per hill is possible.
- Private sector investment is required**.** The government can help in feeder road maintenance, market information provision, extension of the national electricity grid, agricultural financing, provision of modern storage facilities etc. These would contribute to reduce the cost of production.
- The alternative to rent land for *Mucuna solannie* farming (as supported by economic analysis) is better because loss of cropland due to urban development has been identified as one of the five factors affecting crop production in the world. Also, an alternative farmland could be used in case of reduced yield.

RECOMMENDATION

A National Institute of Agriculture Marketing should be established by the Federal Government in Nigeria, similar to CCS National Institute of Agriculture Marketing in India that oversees Guar Gum sales to the United States.

NOMENCLATURE

NCR – Net Cash Recovery
PV – Present Value
KW – kilowatt
KVA - kilovolt amps

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