FINANCIAL FEASIBILITY STUDY OF FIVE BROWN SUGAR MINI-PROCESSING FIRMS IN NIGERIA

BY
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JULY, 2011

DECLARATION

I' **WAYAS, JOSEPH WAYAGARI** hereby declared that the work in this disertation entitled 'Financial Feasibility Study of Brown Sugar Mini-Processing Firms in Nigeria' was carried out by me and that it is a record of my own research work in the Department of Agricultural Economics and Rural Sociology under the supervision of Professor J. F. Alamu, Professor A. O. Ogungbile and Professor T. K. Atala. The information derived from the literatures has been duly acknowledged in the text and a list of references provided. No part of this dissertation was previously presented at any other qualification.

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Chairman, Supervisory Committee

CERTIFICATION

This Thesis entitled **"Financial Feasibility Study of Five Brown sugar Mini- Processing Firms in Nigeria"**, by Wayas, Joseph Wayagari, meets the regulations governing the award of degree of DOCTOR OF PHILOSOPHY (PhD) - Agricultural Economics and Rural Sociology of Ahmadu Bello University Zaria, and is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This work is dedicated to the Designer and Fabricator of brown sugar mini-processing plant who, through the ALMIGHTY GOD's support and mercy, continually makes effort to fill Nigeria's sugar demand gap.

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By

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Wayas, Joseph Wayagari

ABSTRACT

Sugar generally has been described as an international commodity that has become the economic base of some developing countries (Wohlgenant 2008). Countries like Mauritius, Jamaica, and Sudan among others have gained enormous economic benefits like employment generation, increase in living standard of the citizenry from brown sugar processing, thus justifying their existence and improvement (Baron, 1975; 1979; TD, 2001). Why then Nigeria has not developed brown sugar?The broad objective of this project was to study the financial feasibility of five brown sugar mini-processing firms in Nigeria *(*Baizare, in Kaduna State, Sara in Jigawa State, Konar-Mada in Abuja - FCT, Gbajigi in Niger State and Omor in Anambra State). A reconnaissance survey was carried out to identify the locations and number of sugarcane farmers and sugar traders in the study areas as sample frame. Random sampling technique was used in selecting one hundred and sixty-three (163) sugarcane farmers and Purposive Sampling technique was used in selecting the five Brown Sugar Mini - Processing Firms/Processors. Both primary and secondary data were collected for this study. Analytical tools used include; Descriptive statistics, Undiscounted cash flow Measures, Discounted cash flow Measures and Sensitivity Analysis Test models. The results established that; (i). Over 250, 000 hectares of sugarcane land were available in Nigeria. (ii). An average yield of 55 tonnes per hectare was recorded from the respondents across the studied areas. (iii). The average simple rate of return of the brown sugar mini-processing firm was 64%, which was higher than the 25% interest rate prevailing in the capital market. (iv). The Pay-Back Period (PBP) for the investment was three years. (V). The Benefit-Cost Ratio (BCR) of 3.2 was obtained at a suitable discount rate of 25%, which was quite greater than 1. (vi). The average Net Present Value (NPV) at interest rate of 25% was ₦54,005,492.58. (vii).The Internal Rate of Return (IRR) was positive and even greater than 50%, which made the project worthwhile and financially viable and (viii). The sensitivity analysis test carried out using pooled data showed that both 10% and 20% either in increase in cost of processing or decline in prices of output had no negative impact on the project. (ix)The sensitivity indicators were less than 2%, the switching values ranges

between 54% - 71%. The Null Hypothesis, that brown sugar Mini - processing firm in Nigeria is not profitable 'was rejected, while the alternative hypothesis that 'brown sugar mini -processing firm in Nigeria is Profitable' was accepted. The study recommends that; (i). Nigerian government should encourage brown sugar processing using Mini-Processing firms to help in bridging the gap (about 98%) between domestic sugar production and consumption in Nigeria and reducing the heavy amount of foreign exchange being spent annually on sugar importation. It will also be of assistance in providing rural employment and reducing rural-urban migration of youths therby assist in alleviating the poverty of the rural poor. It will also play a part in the realization of the country's vission 20 : 2020. (ii). Financial institutions such as micro-finance banks and Nigerian Agricultural co- operatives and Rural-Development Bank should be well-informed and given courage to grant credit facilities to both sugarcane farmers and prospective investors so as to enhance the brown sugar production in Nigeria .

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CHAPTER ONE

1.0 PROJECT BACKGROUND

More than 100 countries produce sugar (both white crystal and brown sugar), 78% of which is made from sugar cane grown primarily in the tropical and sub-tropical zones of the southern hemisphere, and the balance of 22% from sugar beet which is grown mainly in the temperate zones of the northern hemisphere. Generally, the costs of producing sugar from sugar cane are lower than those of processing sugar beets. In the Year 2009, statistics show that 69% of the world's sugar was consumed in the countries of origin, while the 31% was traded in world markets (ISO, 2009). Because of the residual nature of the world market, the free market price is one of the most unpredictable of all commodity price as indicated by Nadia (1987); Fry (2000); Mahmudulam and Samadmiah (2008) and ISO (2008).

The first sugar production in Nigeria occurred in 1964/1965, after commissioning of Sugar Plant at Bacita {Nigerian Sugar Company, (NISUCO)}, in 1962 (Oguntoyinbo, 1987). This was followed by the establishment of the Savannah Sugar Company (SSC) in Numan 1977 (National Sugar Development Council, 2003). The two sugar plants had a combined installed capacity of 105,000 tonnes/annum or about 10% of the country's annual requirement. Production however, oscillated around 50,000 tonnes / annum, between 1978 and 1990, making Nigerian sugar production slightly less than 5 % of its annual requirement.

*Another sugar plant at Lafiagi/Sunti, Kwara state, was established in the year 1991 with mini works producing insignificant amount of sugar. Since then, no new sugar plant has been established in Nigeria. This may possibly be as a result of the poor and low sugar output experienced from the already established plants. Even at their highest production levels, the two estates (Nigerian Sugar Company, (NISUCO) and Savannah Sugar Company (SSC) could only satisfy about 5 % of the nation's requirement (Table 1.1). For example, as from 1999 to 2006, the production of sugar has been on the decline, reaching an all time low value of less than 2% (*FOS, 1990-2005)*. Thus the wide gap between sugar requirement and production is usually filled through massive importation with huge amount of foreign exchange (NSDC, 2007). In 2008 sugar importation was 98.82% exchange (NSDC, 2008). This cost the country billions of Naira in foreign exchange***.**

Development of sugar processing technology at intermediate or rural levels with indigenous technology had reached a tertiary stage in several other third-worlds countries like India, Cuba, Brazil and Puerto-Rico (Raphael, 2004). In these countries, enormous socio-economic benefits have been reaped, such as generating employment, increasing incomes of the citizenry and raising the living standard of the rural dwellers, thus justifying their existence and improvement (Baron, 1975; Garg, 2007). The dismal performance of the large sugar plants in Bacita and Numan stimulated

brown sugar Mini- processing technology to meet

Table 1:1 Nigeria's Sugar Domestic production, Importation and Consumption trend from 1970 - 2008

Year	Domestic (MT)	Imported (MT)	Consumptionnnnn ('MT)	% Domestic production	% Imported
1970	611	121,610	122,221	5.00	95.00
1971	7,750	164,470	172,220	4.5.00	95.50
1972	10,444	198,446	208,889	5.00	95.00
1973	12,661	281,794	294,456	4.3	96.7
1974	18,489	337066	355,555	5.2	94.8
1975	24,889	419,551	444,440	5.6	94.4
1976	35,556	533,333	516,167	7.53	92.47
1977	27,778	533,333	568,889	6.25	93.75
1978	33,333	555,556	561,111	4.95	95.05
1979	35,556	777,778	588,889	5.67	94.33
1980	40,000	600,000	813,334	4.37	95.63
1981	55,556	811,111	640,000	6.25	996.53
1982	31,111	866,667	866,667	6.41	97.05
1983	26,667	877,778	897,778	3.47	96.20
1984	33,350	844,444	904,445	2.95	93.15
1985	55,600	55,556	877,794	3.80	92.14
1986	66,667	811,111	811,156	6.85	93.71
1987	50,000	744,444	877,778	7.59	91.14
1988	67,680	733,333	794,444	6.29	95.96
1989	35,560	844,444	801,013	8.46	95.57
1990	44,444	855,556	880,004	4.04	95.57
1991	42,222	911,111	900,000	4.43	95.80
1992	35,540	811,111	953,333	4.43	92.2

1993	35,111	722,222	846,651	4.20	95.23
1994	59,072	698261	757,333	7.8	96.49
1995	22,222	611,111	700,067	4.77	97.73
1996	11,111	477,778	633,333	3.51	99.88
1997	555.6	977,778	488,889	2.27	99.55
1998	4,666	753,248	977,778	0.12	97.9
1999	17,000	755,890	757,914	0.45	98.0
2000	36,000	1,209,480	772,890	2.1	99.5
2001	6,720	1,303,875	1,245,480	2.0	100
2002	6,700	1,045,831	1,310,595	0.5	100
2003	0	1,285,599	1,285,599	0.00	100
2004	0	1,233,610	1,233,610	0.00	98.88
2005	0	1,425,678	1,425,678	0.00	98.80
2006	22,000	1,269,000	1,291,000	1.72	98.823.75
2007	20,000	1,538,990	1,558,990	1.20	93.59
2008	18,000	1,500,200	1,518,200	1.18	

Sources: NISCO, 1970-1998; SSC, 1987; Wada et al, 2004; FOS, 1990-2005, NSDC, 2008

domestic requirement in 1996 (NCRI, 1998). It started with a study of the traditional production method for a sugar candy called *mazarkwaila* in some northern states of Nigeria. This was after a test conducted at NCRI, which showed that *marzarkwaila* being a conglomerated sugar crystal and molasses was produced under unhygienic conditions, have low public acceptability rating (NCRI, 1989). In upgrading quality standard of *mazarakwailla* and augmenting the production effort of the few existing giant sugar industries, effort to develop brown sugar processing technology in Nigeria was initiated by the Federal Government in 1986, through the Federal Ministry of Industries. The first prototype plant of 2 tonnes per day cane - crushing capacity was designed, fabricated and tested by the National Cereals Research Institute, Badeggi in 1998. Since then, several research activities have been carried out in order to improve the efficiency of the plant and also up-grade its capacity. The basic unit of the min-processing plants are: weighing, crushing, clarification (heating and settling), evaporation, crystallization, centrifugation and drying. Designs of equipment for each of the units were provided by the engineers NCRI, Badeggi. Fabrication materials were procured locally and all the equipment were fabricated through indigenous effort.

Brown sugar can be defined as granulated sugar having golden colour with 0.1-0.2mm crystal size. It has brix value of 80 -85^0 and dissolves easily in

water. It also has a characteristic chocolate flavor (SSC, 1998). Molasses is the liquid fraction left after separating brown sugar from the massecuite through centrifugation. The molasses of the sugar plant has 70-75^0 brix. As a result, it is still useful for human consumption in addition to other various uses such as production of cough syrup and children drugs in the pharmaceutical industries, alcohols and soft drinks in the brewery Industries, biscuits in confectionery industries and production of animal feeds among others (NCRI, 1997). The only difference with white crystal sugar is the use of chemical treatment using lime and sulphur dioxide gas. This permits the removal of colour matters and allows it to be white (SSC, 1998). The study of the financial feasibility and viability of this brown sugar mini-processing firm was the major concern of this research..

1.1 PROBLEM STATEMENT

Wohlgenant (2008), described sugar as an international commodity that has become the economic base of some developing countries. Countries like Mauritius have no mineral resources and its economy depends mainly on agriculture, and sugar is the most preponderant, representing about 85% of the country's export earnings, 25% GNP and about 70,000 people are employed in the sugar industry (Mauritius' Chamber of Agriculture, 2003). Similarly in Jamaica, according to Paul (1982) and Payne (1991), sugar dominates the agricultural sector, providing employment for over 80,000

people and more than $80 million in foreign exchange earning each year. In these countries, enormous socio-economic benefits like employment generation, increase in living standard of the farmers and producers have been reaped, thus justifying their existence and improvement (Baron, 1975; 1979; TD, 2001; Rao and Reedy, 2008*).* Why then has Nigeria not developed brown sugar?. Specifically, pertinent research questions are as follow:

1. Are there suitable lands available for the cultivation of sugarcane in Nigeria
2. What is the average yield per hectare of sugarcane in the areas where the brown sugar mini-processing firms are located?
3. What is the simple rate of return of 10 tonnes crushing per day (TCD) of mini-brown sugar cottage firm?
4. What are the inputs for brown sugar mini- processing firm
5. What is the Pay –Back-Period (PBP) for the brown sugar mini-processing firm?
6. What is the Benefit – Cost Ratio (BCR), Net Present Value (NPV) and the Internal Rate of Return (IRR) of investment in brown sugar mini-processing industry?
7. What will happen to return on investment in the brown sugar mini-processing firm if there is an increase in costs of production or decline in the price of the product?

1.2 OBJECTIVES OF THE STUDY

The broad objective of this work is to study financial feasibility of five brown Sugar Mini- processing firms in Nigeria. The specific objectives are to:-

i. assess the availability of land for sugarcane production in Nigeria,

ii. find out the output (yield) per hectare across the areas where the Mini-processing firms are studied.

iii. determine the simple rate of return of 10 tonnes crushing per day (TCD) mini brown sugar cottage firms.

iv. identify the inputs for brown sugar mini-processing firm.

V. appraise the Pay-Back-Period (PBP) of the brown sugar mini – Processing firm.

vi. estimate the Benefit-Cost Ratio (BCR), Net Present Value (NPV) and the Internal Rate of Return (IRR) of investment in brown sugar mini- Processing industry.

vii. evaluate the effects of changes in processing cost and decline in the Price of products (brown sugar and molasses)

1.3 JUSTIFICATION FOR THE STUDY

In the 1980s and early 1990s, Nigeria was consuming an average of 800,000 - 900,000 tonnes of sugar annually. The combined sugar production from the two Sugar mills (Bacita and Numan) at that time hovered between 30,000 – 50,000 tonnes/annum. Thus, domestic Production as of then was about 4 – 6% of the Nigeria's total sugar

demand; the remaining 94% was imported. In order to accelerate sugar production therefore, the 'National Sugar Development Council' (NSDC) was established by decree 88 of 1993, and the NSDC gradually set a target of achieving the production level of 70% of the country's sugar requirement by the year 2000 (NSDC, 1995). Since its inception however, the NSDC had achieved nothing up to the year 2000 (NCRI, 2001). This made the Government privatize the two sugar estates (Bacita and Numan) in 2003 and 2005 to Dangote Nig. Plc and Joseph Dam Nig. Plc. respectively.

During the years 2003 – 2005, Nigeria imported 100% of its sugar requirements (Wada et al., 2006; NSDC, 2006). In the recent years (2006 – 2008), after privatization of the sugar mills, domestic production has crashed thus, importation went up from between 98% to 99% (NSDC, 2008). The study was significant because development of brown sugar mini- processing firm will benefit sugarcane farmers in terms of employment and earning more income, it will benefit traders through employment generation, reduce rural - urban migration by the youth, benefit the Government and people of Nigeria in terms of foreign exchange conservation, will be of assistance to the Nigerian government in amending its policy on sugar importation and also play a role for the realization of Vision 20: 2020

1.4 HYPOTHESIS OF THE STUDY

The hypothesis tested in this study:

H_o. Brown sugar mini -processing firm is not a profitable project in Nigeria

H_1. Brown sugar mini-processing firm is a profitable Venture in Nigeria

2.0 LITERATURE REVIEW

2.1 SUGAR PRODUCTION IN THE WORLD

According to ISO (2009), a total of 167.6 Million metric tonnes of sugar was produced in 2008, which was 6 million metric tonnes over the total production of 167.6 million tonnes in 2006, due mainly to advances in sugar technology in major producing countries. The total number of countries engaged in the world sugar trade-production, consumption, import and export are about 125, but the major players in all of these segments form less than 20% (Busari, 2004). Sugar is unique in the sense of being perhaps the only commodity where the major producers/exporters are also the major importers. For instance in 1999, the European Union (EU) countries as a block, were the largest producer and consumer of sugar; producing some 19.3 million tonnes and consuming 15.0 million tonnes of the commodity respectively (ISO, 2008). Yet, the EU was also the second largest exporter and importer in that year. Sugar production of some selected countries in the world is briefly highlighted below.

2.2.1 Brazil

Lee (2008), stated that Brazil is the World's largest sugar producer, and that decades ago, it had two distinct producing regions; one in the north east and the other in the centre-south region of the country. However, with expansion of the industry, practically the whole country became a producing area, with Sao- Paulo State as the most important region. Brazil's

sugar production for the year 2008 was 31,000,000 MT and exported 7, 700,000 MT (Fernandez and Irvine, 2008).

2.2.2 Thailand

Thailand, the second world largest sugar producer, though small country, has been producing sugar since time immemorial. According to Khan and Khan (2004), indigenous brown sugar (muscovado) was exported to Japan in 1822 during the Krung Tattanakosin period. Currently (2007/2008) sugar export has reached 5 million tonnes and has been considered as second world largest sugar production – 20.14 million metric tonnes in the year, 2008 (Rao and rdchana, T., 2008), and that its sugar production is still on the increase, because of the large demand by countries like Indonesia, Japan,, Malaysia, china, South Korea, Philippine and Russia.

2.2.3 India

Solomon (2008) in his write-up has considered India as the original home of sugar production in the world and is the third largest world sugar producer. The art of sugar making according to Solomon, was known during 4^{th} and 6^{th} centuries and numerous references have been made in the old scriptures. Industrial centrifugal sugar production in India started in the mid 1930's in sub-tropical belt. The Indian sugar industry according have achieved the unique distinction of being largest producer of white plantation crystal sugar in the world through its extensive network of 540 sugar factories located throughout the country. These factories were located

mostly in the rural areas, act as nuclei for their development by mobilizing rural resources and generating employment, transport and communication facilities. Over 50 million farmers and a large mass of agricultural labour were involved in sugarcane cultivation. It therefore, plays a major role in rural development in addition to sweetener suppliers. Land area of 4.36 million hectares are under sugar production in India and sugarcane output of 281.57 million tones are produced yearly, which gives sugar (both Brown and white crystal) of 19.24 million tonnes and this generate foreign exchange of US$ 3 billion/annum.

2.2.4 China

According to Professor Yang-Ruili (2008), Sugar production in china has more than 3000 years of history. Prior to 1840 A.D., china dominated the world trade of sugar but the sugar industry became very weak since then due to long time of wars and unstable social conditions. It has been developing rapidly again since early 1980s. China is the fourth largest sugar producer in the world with 13.12 million metric tonnes of sugar output during the year 2006/2007 milling period (Yang-Ruili, 2007).

2.2.5 Cuba

Cuba was the sugar bowl for the USA, which exercises strict control over imports by quotas. After the Second World War, sugar prospered but after the Castro regime took over, in 1963, such foreign-controlled industries were nationalized and Cuba switched to Soviet Union as the major outlet for

its sugar. For some time in the 80s, the industry went into declined producing about 4 million tonnes (Busari,2004) which represents 50% of its peak production, but it bounced back such that by early 90s, it had regained its former production level (around 8 million tonnes). It has since steadily gone into decline again producing less than 4 million tonnes in 1999 (ISO, 2000). The government is of course heavily in control and rejuvenation programme has been put in place. This is gradually yielding the desired results as production in 2008 has climbed up to over 5 million tonnes , making it the fifth world largest sugar production. If the necessary political will is demonstrated, Cuba has all it needs to produce more than 10 million tonnes annually (ISO, 2008).

2.2.6 North America

The Sugar industry in North America comprises three countries- United States, Canada, and Mexico, each with its own perspective and challenges. These three countries account for about 15.6 million metric tonnes of both cane and beet sugar production (Magarey, 2008). Of this total, the United States accounts for 6.2 million MT, Canada 3.2 million MT and Mexico 5. 2 million MT. Mexico is a cane sugar producer, is currently (year,2008) a net exporter of sugar. The sugar industry has changed a great deal in each of these countries over the past decade, with trade, economic, dietary, regulatory, environmental and social issues all having impact.

2.2.7. Egypt

Sugar production started long time ago in Egypt. Historian reported that sugarcane plant was well known in Egypt around the beginning of the fourth century from the Euphrates region before the Arabs entered Egypt. However, others reported that the Arabs were the first to commercialize sugar production during the rulings period of Ahmed Ibn Tolon (ca 868 AD) and later in the era of the Fatemi State which started in Cairo in 983 AD. The manufacturing of white sugar cones to be exported to Europe was an Egyptian industry during the ninth and tenth century. As from years 2003-2007, Egypt has nine sugar factories at Hawamedia devoted to sugar refining only (Adel, 2004; Nasr *et al., 2008*). The reporter claimed that about 1.285 million metric tonnes of sugar were produced by Egypt in 2004, and that increased to 1.582 million in 2008 (Nasr *et al 2008)*

2.2.8 Sudan

Sudan was really the only remarkable success story of sugar production in Africa apart from South Africa and Egypt. Out of about 8.5 million metric tonnes produced in the continent in the year 2008, Sudan alone produced nearly one-third (ISO, 2008). Production has crossed the 1 million tones mark in Sudan since 1999 and is still rising. In 2000, reports said the country produced nearly 0.7 million tones mainly from the Kenana sugar Company (which produced over 450, 000 tonnes) and other government – owned factories producing between 700- 1000 thousand tonnes annually.

The sugar industry in Sudan receives huge concessions and support from the government which seemed to have decided to use the industry as the major vehicle of its rural development programmes. Such concessions according to Busari (2004); include the annual sales agreement between sugar companies and government which requires the latter to buy over 50% of total production for domestic market at twice the cost of production. This guarantees a steady cash flow for the companies' operations. Imported sugar is priced at least $50 above the price of domestic sugar in Sudan, in order to further protect the local industry. Given the strategic role of the industry in the economy of Sudan, the government has plans to commission two more plants- the White Nile and Blue Nile Sugar Plants- both of which, upon completion in 2006, are expected to add some 300,000 tonnes of sugar to Sudan's current annual production. Table 2.1 below shows production of sugar in some selected countries of the world.

Table 2; Some Selected Countries and their Sugar Production for the past Decade (1997 – 2007) in Million tones

Year	Brazil	Thailand	India	China	USA	Cuba	Egypt	Sudan
1997	10.4	12.04	8.4	6.22	7.37	3.26	1.28	0.61
1998	13.8	12.04	10.3	6.28	7.26	3.87	1.33	0.63
1999	15.6	12.3	9.4	8.11	8.01	4.05	1.39	0.67
2000	17.6	18.51	9.8	8.82	8.34	4.35	1.53	0.75
2001	22.5	18.5	13.5	6.20	8.72	4.35	1.55	0.78
2002	23.4	18.8	16.2	8.50	8.89	4.38	1.55	0.85
2003	23.6	20.14	16.4	10.6	8.74	4.47	1.44	0.86
2004	25.0	20.16	15.8	10.02	8.39	4.53	1.46	0.92
2005	25.7	20.35	13.6	10.5	8.59	4.67	1.56	0.98
2006	25.8	20.68	16.5	10.62	8.64	4.75	1.64	1.02
2007	25.3	21.2	17.3	10.73	9.23	5.05	1.86	1.052.
2008	31.0	23.5	20.14	10.2	10.3	5.36	1.52	2.76.

Sources: Nanning, Guangxi. China, 2004 and Licht, 2007; Food and NSCD, 2008

2.3 THE WORLD SUGAR MARKET

Sugar is important to the world economy. According to Michael (2007), for years 2006-2007, world sugar production totaled 112.5 million metric tonnes (MT) with world trade of 28% of world production for those years. Despite the significance of trade, the world sugar economy is characterized

by heavy government intervention both domestically and internationally. Sugar is produced from both sugarcane and sugar beets. Sugarcane is grown primarily in tropical and sub-tropical climates while sugar beets are grown where the climate is more temperate. Lower income countries, which rely more heavenly on sugar as a source of income, tend to have fewer tariff barriers than high-income countries which more heavily subsidize domestic production-often at the expense of domestic consumers (Devadoss and Kropf, 2007). In Addition, protective domestic support policies for sugar have encouraged growth in High Fructose Corn Syrup (HFCS) consumption, especially in the United States and Japan.

The policy provisions of the Uruguay Round Agreement (URA) for agriculture include market access, domestic support, and export competition provisions. The URA is a first step at addressing trade barriers between countries by attempting to convert market distortions to tariff equivalents. In most instances, tariff equivalents were derived based on the difference between internal and external or border prices (Santana, 2007).

Countries participating in the agreement committed themselves to replacing non-tariff barriers with tariffs and then reducing these tariff equivalents over a period of time. Reduction commitments are expected to be achieved

through reducing domestic price supports.

Aside from tariff reduction commitments, the United States and EC are subject to the market access provision of minimum imports of 3 percent of consumption of sugar, which becomes 5 percent at the end of 2000. The United States provides access to its sugar market through quota allocations to specific countries at reduced import duties. The EC also provides access to its sugar markets through special preferences to exporting countries, especially the African, Caribbean and Pacific (ACP) countries. For a certain quota, ACP countries are able to sell without paying any import duty. For certain quantities above the fixed quota of about 1.3 million per tonne, ACP countries can sell at a reduced duty of about 85 percent of the EC reference price (Santana, 2007). Currently (year 2008), the world price of sugar is US$ 536/tonne (NSDC, 2008)

2.4 SUGARCANE/SUGAR PRODUCTION IN NIGERIA

The production of sugarcane in Nigeria is a major farming business performed by different communities who have the suitable climatic condition for producing sugarcane. Study conducted by NCRI, Badeggi in the year, 2008 shows that there are over 75 communities farming sugarcane scattered in about 26 States of the Federation (NCRI. 2008).

Oguntoyinbo (1978) in his paper titled, 'The Ecology of Sugarcane Production' stated that although local sugar processing started around the

1920s, it was not until the early 1960s that industrial manufacturing of refined sugar commenced in Nigeria. As at 1954, only about 43,000 tonnes of refined sugar was being consumed in the country and all of it was imported. There are no records of the amount of crude sugar cakes produced annually in Nigeria, even up till now –year, 2008.

Having observed that sugarcane thrives well in the country and in a bid to stem the rising dependency on imported sugar, the colonial government in 1956 commissioned a general survey of the areas of potential sugarcane and sugar production. Although about 8 locations were identified by overseas sugar experts, Bacita was finally chosen as the site which seemed to satisfy most of the necessary conditions. The government of the time accepted the report early in 1958 and commenced its implementation by establishing a Nigerian Sugar Syndicate which carried out a 3-year test sugarcane production trials at Bacita. About 12,500 hectares tract of land was subsequently acquired for sugarcane production at the sites, half of which was used. The syndicate in their final feasibility report recommended the formation of the Nigerian Sugar Company, a limited liability company that was incorporated on October27, 1961. The company's factory which was commissioned in 1964 had a final installed capacity of 40,000 tonnes/annum and its first product came out in 1964/65.

A subsidiary of booker McConnell of great Britain- Bookers (Nigeria) Limited

– was appointed the managing agent for the new company in 1967 and then ran it until November, 1972 when they became the company's Technical Service Advisers under a new agreement. Although the technical service agreement was not terminated until 1981, by 1973, Nigerians had assumed managerial control of the estate at Bacita. While Bacita was being developed, Nigerians thirst for sugar has increased tremendously, so that by 1974, Nigerians were already consuming over 350,000 tonnes of the commodity annually. This prompted the government again to look into establishment of new sugar mills. Expert again was commissioned to carry out feasibility study in Numan, Lafiagi and Sunti. Following their report, the Savannah Sugar Company Limited (SSCL) was incorporated and the commonwealth development Corporation (CDC) was appointed the managing Agent on April 29, 1975. They continued in this role until May 31, 1982, when the agreement was terminated. SSCL, Numan has an installed capacity of 65,000 tonnes /annum and its first production came into the market in 1980/81. Cane was produced from about 5000 hectares out of a total of 22,000 hectares originally acquired for the purpose.

While the Numan project was going on, the government in 1971 brought over the Mehta Group from East Africa to undertake preliminary studies on the setting up of additional sugar projects in the country. The group examined two sites – Iyansan in the former Western region and Lafiagi in

the present Kwara State – and finally recommended the later for development. A Technical co operational Agreement between the Federal Government and the Mehta Group was signed in October, 1975. In August, 1976, the group was appointed Manager and Consultant to the Lafiagi Sugar Company. The development of the project however, had to be stopped for a number of reasons, among which was their proposed Lakota hydroelectric project which never take-off. Sugarcane cultivation at the site however continued on about 180 hectares of land, while harvest was processed at Bacita. Nothing much happened at Lafiagi since then, but with NISSCO, Bacita Technical partners, a mini manufacturing plant of 100tcd capacity was commissioned at Lafiagi in 1993, producing about 2,000 tonnes of sugar annually.

At about the same time, a cooperation Agreement was again signed between the then Western State Government, Federal Government and Tate and Lyle (Nig) Limited for the development of the Sunni site (FM CI,1976). The agreement signed, in 1973, was later to be terminated in 1975. The Sugar Consultant Consortium (PTY) of Sidney, Australia, was next invited to execute the Sunti project. The Consortium, submitted a report in 1977, the Federal Government appeared by then to have changed its mind and decided instead to invite a consortium made up of USSR, Poland and Cuba to continue the development of the Sunti project (NCRI,

1987). The new consortium submitted a feasibility report for a 100,000 tonnes per annum sugar factory and 7,500 tonnes / annum fodder yeast plant. Final agreement was initiated in October, 1979, but the Cubans decided to opt out of this agreement on Aprill21, 1981, just when the Sunti sugar Company was set to sign the contract agreement with the consortium. Since then, the Sunti Sugar Company has not really taken off despite the invitation of other overseas companies like the SAMAG Ag, (Germany), Inter America etc, for its development. It however, continues to produce sugarcane which it sells to Bacita for processing, from about 350 hectare land out of about 15,000 hectare originally acquired for the purpose. The National Sugar Development Council (NSDC) has also begun funding the establishment of a 250 tcd sugar plant at the sunti estate. The major work was being carried out by the Nigerian Sugar Company, Bacita, which is also the technical partner. This factory is yet to commence operations. A Mini brown sugar plant of 10tcd capacity – which I'm currently studying its feasibility was also commissioned by both the NCRI and the Jigawa State Government in 1999. Due to the State government 's policy and misunderstanding between the emirate councils in the State, the plant after one year of successful operation was suspended up to today (2008). According to NSDC report (April 2004), NSDC has also commenced plans in 2004 to establish, mini brown sugar plants in Kano, Gombe and six

other sites (Zigau, Kauran Mata, AGbede, Girinya, etc) as well as resuscitating the old plant at Makarfi, which has not come into reality up to this day (2008).

In the same vein, the Ogun State Government invited the Cubans to explore the possibility of establishing a sugar mill at papalanto area of the State in 1993, but nothing concrete came out of the proposal (OGSDP, 2006). Instead a private investor, Gayvita Nig. Limited in Abeokuta, Ogun State, has indicated its interest in setting up a sugar factory in the same area. The company has hired private consultants to advise it on the feasibility of the project but its plans are still on drawing board. In effect therefore, only one sugar factory (Danggote Savannah Savannah Sugar Company, Numan) is at the moment functional in Nigeria. As of today (2008), there has been only one major addition to the sugar industries since the 1980s. This is the huge sugar refinery being established by the Dangote Group in Lagos. The refinery, which was commissioned in March, 2000 has the capacity to produce 650,000 tonnes of refined sugar annually. Although its impact is yet to be felt, it is projected that with this new refinery, importation of refined sugar by Nigeria will decline (Busari, 2004).

2.5 NIGERIA SUGAR CONSUMPTION TREND

According to Busari (2004), while domestic sugar production was increasing very gradually and witnessing serious depression in some years, the outlook

of sugar consumption was on a dramatic rise. As started earlier 43, 000 tonnes was consumed by Nigerian in 1954; but by 1975, two decade later, Nigerian were consuming about 440,000 tonnes of sugar, an upsurge of over 900%. Within the next decade – up to 1985, the consumption had more than doubled the 1975 level to about 877,794 tonnes. Since then, domestic consumption had hovered around 800,000 - 900,000 tonnes annually up to 1992 (FOS, 1993). Indeed, a negative growth rate was recorded in sugar consumption between 1991 and 2000 (NSDC, 2004). From 1973 to 1991, which in retrospect marked the best years, domestic production ranged between 20,000 -54,000 tonnes/annum. In effect, Nigeria had only been able to produce between 4.0 -6.0 % of its annual sugar requirement in those years, with the shortfall being supplied through importation, whose trend closely followed the consumption pattern. Between 1995 and 2000 (FOS, 2001). The production outlook became much worse ranging between 4000 – 16,000 tonnes/annum. It would appear however that this dismal picture is set to change with the commissioning of a new big refinery by the Dangote Group in Lagos producing about 250,000 tonnes of refined sugar annually. Importation of refined sugar is expected to be ¾ from its current level of 250,000 tonnes in 1999/2000, while the importation of raw sugar will increase four times from the current 120, 000 tonnes to about 500,000 tonnes. The fact

remains however, that the bulk of the sugar consumed in the country will still be imported, either in its raw or refined form. Right from inception the sugar industry has never been able to satisfy the nations requirements, but even worse is the fact that the nations's capability to do so has been dwindling from the 70s. Reports by Busari (2004) and NSDC (2008), shown the domestic sugar production as a percentage of consumption in Nigeria over the past three and half decades. The figures told the sad story of the Nigerian sugar industry.

2.6. INDIGENOUS SUGAR PROCESSING TECHNOLOGY IN NIGERIA

The history of indigenous processing of sugar cane into traditional recipes in Nigeria dates back to the early 18th century. By the 1920s, according to Busari (2004), the technology for the production of crude cakes called mazarkwaila (Hausa) had been developed. Reports had it that during the First World War, some mills were imported by the British colonialists to assist local *mazarkwailla* makers in increasing their output of the sugar cakes for consumption by African soldiers who were reported to relish it (Misari, 1996). With advent of the advanced technologies of refined sugar production, nothing happened much by way of improvement to the local processing technology. Till today, the method, the method has reminded the same with the exception perhaps in the use of motorized cane crushers, to replace the use of horse-powered crushers by some local processors

(NCRI, 2006). Local people using this technology are still prevalent in many states of the northern Nigeria, especially in the Anchau, Makarfi and Rogo areas of Kaduna, Kastina and Kano States respectively.

The only significant improvement of the indigenous technology came when the Federal Government of Nigeria set up a task force in 1996 to design, fabricate and commission a prototype mini brown sugar processing plant (NCRI, 1998). This was against the backdrop of the need felt by the Government to upgrade the quality of the local sugar cakes and thereby augment the production effort of `the then big sugar industries in the country. According to NCRI reports of April, 1999; The first prototype plant having a crushing capacity of two tonnes of cane per day (2 tad) was commissioned at the National Cereals Research institute (NCRI) by the then Minister for Science and Technology, Prof. E. U. Emovon in March, 1998. Some designed faults were said to have been identified in the first prototype juice extractor and this led to redesigning and fabrication of a 5-roller type double action extractor (1989 model) whose juice output was marginally better (FMST, 1990).

The federal Ministry of Industry took further step towards the advancement of this prototype plant to the first stage of mass adoption by funding the development of a pilot plant with a crushing capacity of 10 tcd. This plant was commissioned at Sunti. Apart from the original open pan evaporation

system and the platform dryer which were modified and improved upon, a 3-roller type single action juice extractor (1990 model) also formed part of the pilot plant. Further development on the project was stalled due lack of funds until 1995-96 when funds were made available from the World Bank Assisted National Agricultural Research Project (NARP). Scientists and engineers at the Sugar cane Research Programme of NCRI, Badeggi were able to produce new and generally more efficient designs of the various components, culminating in the assembly of the 1996 model. Under a joint sponsorship of the Jigawa State Government and the NCRI, the 1999 model of the mini brown sugar plant was also produced, incorporating improvements, mainly: The cane juice extractor whose single unit now has a crushing capacity of 5 tcd, the open pan boiler that now has an underground furnace and the use of local plant extracts in juice clarification. A prototype model of this plant was established in Sara, in Gwaram Local Government Area of Jigawa State, and Commissioned by the then Honorable Minister for Agriculture, Alhaji Alfa Wali in March, 1999. Further improvement was also made on the cane juice extractor and renamed cane crusher/juice extractor which are said to have 96% efficiency (NCRI, 2008) which have been commissioned at Kona-Mada, in Gwagwalada FCT, Abuja in 2004, Bazaire Village near Zaria in Kaduna State, Omor in Anambra State in 2008 and the forth is waiting commissioning in Ibaa of River State.

The product from the plants is free flowing granular brown sugar and differs from the crude sugar cake (mazarkwailla) in several respects. Basically, the latter is a conglomerate of sugar crystals and molasses whisked into an edible solid form. Tests at NCRI have shown that it is hygienic as none of the impurities harvested with raw sugar cane are removed during processing, and also tests conducted by the NAFDAC in 2001 have confirmed that the brown sugar is fit for human consumption (NOTAP, 2002) and can be used for a diabetic patient

2.7. LIKELY REASONS FOR THE STATE OF SUGAR SITUATION IN NIGERA

In attempting to adduce reasons for the unwholesome sugar situation as succinctly presented in table 2.1, there are needs to review at both the demand as well as supply sides;

2.7.1 Demand side (Consumption)

Lafiagi (1984) and Busari (2004) had quoted a statement by John M. Mount, then Vice president and Director of Purchasing, Coca-Cola, USA, to explain the general pattern of consumption witnessed in Nigeria:

Sugar has been regarded throughout the countries of the world as one of the things of life. Among food items, it is one of the most basic luxuries as well as a very low-cost source of food energy. It is the food whose consumption grows most dramatically with economic improvement in a

country. Where people have more discretional income, their consumption of the good things increases. This has certainly been seen in increase in consumption that has occurred in the developing countries of the World as their standard of living improved.

Indian's domestic consumption of sugar as food for 1978 went up by 30% over 1976 consumption; China's was up by 27% for the same period, Sri Lanka's consumption was up by 165%. These are not isolated examples. These are clear indication of what occurs and what will continue to occur in areas of the World that are just beginning to show economic improvement. Sugar will continue to serve people not only as an inexpensive food source but also as a basic luxury. The implication of this in the use of sugar cannot be ignored. Lafiagi added:

> Sugar consumption grows in line with urbanization and general economic improvement of every society. It may be stated, that as Nigeria develops, sugar consumption will increase in line with Population growth and changing standards of living standard.

The Surveillance of both gentlemen is borne out clearly by the Nigerian situation. No one can now deny that the years of rapid growth in sugar consumption coincided with what had come to be known in Nigeria as the *oil boom* years, when the country recorded its fastest economic growth and rapid urban development. It was also the time when there were significant increases in per capita income and the standard of living of the average

Nigerian (Through the *Udoji awards),* coupled with increase in population. These were the years from the end of the civil war in 1970 to 1980 when sugar consumption rose from 115,000 tonnes to 815, 000 tones, recording over 20% increase when averaged over the decade. The reasons for the meteoric rise are not hard to seek .Within that period, 10 big soft drinks plants were established across the country (Busari, 2004). Up to the end of the war, Nigeria had just four functional Pharmaceutical industries, but by 1980, there were 21 such industries (M.A.N., 1985). The number of breweries also tripled, while the production market sector leaders like the Nigerian Breweries Limited (NBL) also tripled with the establishment of new plants at Abe, Kaduna and Ibadan. Confectionery manufacturers also multiplied in number and all these companies were recording record level sales in economical buoyant country. The demand of sugar by all the industries was largely responsible for the record- breaking consumption pattern.

2.7.2 Production (Supply Side)

The causes of the dismal outlook of production by the local sugar industry reviewed are multi-dimensional. The major ones as started by Busari , 2004 are:

i. Too few operating sugar mills

ii. Law capacity utilization in the existing mills

iii. Availability of cheap imported sugar

iv. Continuous inadequate supply of raw materials (Sugar cane)

v. Variety of factory and field -related production problems

vi. Lack of improved indigenous processing technology

vii. Lack of statutory regulatory organ on sugar cane and sugar Research and Development, etc

Apart from the new Dangote refinery which started production in 2000, there were only two major operating mills in Nigeria, both established in the early 60s to 80s. Successive government since then have derelict or failed to invest in this vital sub-sector all through our so-called **oil boom** years, despite so many feasibility studies and expert reports.

As had already been shown, even if the two sugar mills were producing at full capacities, their combined production would still amount to a pinhead in the haystack of Nigeria's sugar requirements. But sadly, the NISUCO factory operated at an average of 60% of its installed capacity and the situation has steadily worsened in the last few years of its existence. In 1994, it produced only about 20% of its installed capacity (Table 2), and the worse happened in 1996 (15%). By year 2000, it appeared the company had all but collapsed. Therefore, by the year 2003, not only were no new sugar factories commissioned, but the existing ones were no longer operational

The progressive decline in local output could in part be explained by the

availability of cheap imported sugar from the so-called world market (Michael, 1999). In spite of the relatively lower variables costs (e.g., very cheap labour etc), the unit cost of production of local sugar is invariably higher than prices of imported sugar, due largely to the heavy subsidies and varied grants enjoyed by producers who dump their surplus sugar on international market. As often highlighted at the World Trade Organization (WTO) trade summits, these subsidies, especially by the developed economies, significantly distort international market prices of commodities (Mainly Agriculture) to the detriment of developing economies (Gbabo *et al., 2008)*. It is highly unlikely that countries like Nigeria could produce commodities like white crystal sugar at costs that would be low enough to match the prices of the cheap imports. Such low returns on output over time, have a serious negative impact on productivity. In such circumstances, government ought to enact clear policies that would at least mitigate these negative impacts

According to Wada *et al. (2004),* the estate-based nature of industrial sugar cane production in the country has also not helped the existing mills. Generally, not enough raw materials are produced to keep the factories in continuous operation. Often, the crushing season does not last beyond four (4) months due to lack of sugar cane to crush and efficiency of sugar recovery is relatively low in both factories. The causes of these according to

writers - are variety of factory and field-related production problems like the use of the low yielding varieties (all of which were imported), water management (Irrigation) problems, natural disaster like draught or sudden attack of diseases like the devastation by smut at Bacita in 1975, poor control of weeds, insect pests etc. Most of the problems could be solved through research, but research on sugarcane in Nigeria is weak and incapacitates or injured as already highlighted. Sugar companies and industry that rely on sugar for operations have neglected the necessary investment in research and development efforts, preferring instead to import sugar and sugar cane planting materials directly as well as other improved technologies from abroad. Many of the imported varieties have totally declined in yield.

2.8 SUGAR REASERCH AND DEVELOPMENT IN NIGERIA

The miserable performance of the large -scale sugar plants in Nigeria prompt research interest in sugar processing technology for sustainable production at cottage levels in 1986 to meet domestic requirement. This started with a study of the traditional production method for a sugar candy called *mazarkwailla* among farmers in some northern states of Nigeria (NCRI, 1996). This was after tests conducted at NCRI, Badeggi showed that *mazarkwailla*, being a conglomerated of sugar crystals and molasses, and produced under unhygienic conditions had low public acceptability rating.

In Upgrading quality standard of *mazarkwailla*, and augmenting the production effort of the existing giant sugar industries, a task force was set up by the Federal Government of Nigeria to design, fabricate and commission a prototype brown sugar plant using adopted technology (NCRI, 1996). Consequently, the National Cereals Research Institute, Badeggi was given the national mandate to co-ordinate and see to the setting up of the plant at its Headquarters (Badeggi) of Niger state in 1997. Accordingly, a 2 tonnes per day (tcd) capacity cane crushing prototype brown sugar plant was developed and commissioned in the institute in 1988 (NCRI, 1988). Thereafter, several researches aimed at improving the efficiency and capacity of the technology have resulted in the development of a 10 tcd mini brown sugar plant. An operational unit of this has been established at Sara, near Duste in Jigawa State, at Kona-mada in FCT, Abuja. This technology according to NCRI management is earnestly yearning for immediate support by wealthy entrepreneurs and other stakeholders in the sugar industry for mass production for sitting in every sugar cane growing community in Nigeria for the attainment of sugar self-sufficiency and for export - and these are component of the plant this study is assessing its financial feasibility and viability .

2.9 CONSTRAINTS IDENTIFIED FOR THE DISMAL PERFORMANCE OF THE NIGERIAN SUGAR INDUSTRY

The National Cereals Research Institute, Badeggi; that has national mandate on sugar and sugar cane improvement in Nigeria, in its sugar cane production and processing manual (NCRI, 2008), identified major constraints for the dismal performance of the Nigerian sugar industry as:

1. Because of the ever competing demands on the resources of government, funding cannot but be inadequate. This is at variance with what obtains in other sugar producing countries of the World. According to the NCRI, report (1988) , the responsibility for funding research in those countries is shared between government, the sugar companies and the cane growers.

2. That there is an apparent non-appreciation of the Potential role of research in the principal stakeholders in the sugar industry. While there is no lack of awareness of the need for improved sugar cane varieties for sustained high yields, for instance, the sugar companies have failed to take any concerted action to promote the establishment of a viable sugar cane breeding programme in the country. Rather the managers of the companies appear to be contented with the continuous importation of exotic materials for commercial cultivation on their estates.

However, as reported by Allison (1980), no more than 2% of the 227 exotic varieties imported by NISUCO from inception up to that time of report

(1980) were still being cultivated on a commercial scale

3. A fall-out of the non-involvement or the very limited involvement of the Companies in supporting research on the crop is the partial or non-utilization of indigenous research findings and the lack of a feedback mechanism. For example, it is not clear whether any of the company estates are currently evaluating or have adopted any of the four indigenous Bred sugar cane varieties, which were released around 1998 by NCRI, Badeggi

4. In addition to inadequate funding, there is lack of central coordination of the direction of Research in the sector. Such coordination will set research priorities based on the appraisal of all the stakeholders and determine the activities that should have funding support from a central body and,

5. Finally, probably because the bulk of industrial cane cultivation was carried out by the sugar estates, there is a poor or non- existent of extension support system for the local farmers engaged in sugar cane cultivation. The writer concluded by saying that the net effect of the above situation is that there has been a gradual but definite decline in the scope of research institutions and personnel involved in such research activities over the years, 'which personally agree with him'. And, that if this is allowed to continuous, it will not augur well for the development of the industry in the country.

2.10 POTENTIAL IMPACT OF THE SUGAR INDUSTRY ON THE NATIONAL ECONOMY

It is easy to project the potential impact of this sector on the national economy assuming the enabling environments for its provided. According to NCRI, 2008 report; current domestic demand for sugar in Nigeria stands at between 1,500,000 - 1,700,000 metric tonnes, which is equivalent to $711 - $989 million. However, almost nothing is produced as from the fourth year of 21st century (Table 1). This is because, the sugar industry in Nigeria, since inception had been operated by the government with continued dwindling productivity and pile-up liabilities (Imolehin *et al, 2008)*

The lack luster performance of these industries informed government on the Liberation of the sector. Thus, the two major sugar companies located at Bacita (Kwara State), and Numan (Adamawa State) respectively have been Privatized. The sugar situation becomes worst in late 1990s and at the year, 2008, almost no sugar was produced in the country. Sugar consumed was importation. Over 1.5 million tonnes annually were imported as from 2001-2008 (Central bank of Nigeria (CBN) Annual Reports and National Sugar Development Council Data, 2001-2008)

Is hoped that the private sector - operated sugar industry would collaborate and support research as a vital components for its development by funding demand driven research, a service which almost non-existence from the

sector for now (2008)

In spite of the non-supportive role by the collapsed sugar industry for R & D, the National Cereals Research Institute (NCRI), Badeggi at the instance of the Federal Government has developed a 10 tcd brown sugar plant for sitting in identified sugar cane growing communities as pilot plants which this study is presently looking at its financial feasibility.

2.11 Reviewed Empirical Studies

Several related studies carried out by; Austin, 1980; Brown, 1980; Lamson, 1984; Dionco, 2001; Ping and Liang, 2002; USDA, 2002; Pesce, 2004; Vinodh and Sundararaj, 2008; Marion and Fraser, 2008 were reviewed. The literatures uncovered that descriptive statistics, Undiscounted, discounted cash flow Measures and sensitivity analysis test (SAT) were used. Dr. Carlos (2000) also carried out study titled 'Feasibility Study on Project Funding in Emerging markets'. Similar analytical tools were used and recommendations were arrived at. A study on Feasibility study on World Bank Education Projects outcomes was carried out by Gittinger (2001) using discounted cash flow measures, it was found that there was a strong relationship between the quality of Cost-benefit and cost – effeteness of the project outcomes. Gamassy (2008), in his work on feasibility study on 'growing jatropha utilizing treated wastewater in Luxor', used the same analytical tools (Undiscounted and discounted cash flow measures). All tools

used were good source of indicators for a promising investment opportunity and recommend that such tools could be of great help in determining success or failure of a project. Using the same analytical tools also OSPREY (2008), recommended Ethanol Investment as a profitable project to Niger State Government. The author did not see any issue of criticizism in the reviewed papers so far.

2.12. Reviewed Analytical Tools

In search for analytical techniques to be used in this study, the author having been convinced from the several literatures reviewed adopted the descriptive statistics, Undiscounted cash flow Measures {Simple Rate of Return (SRR) and Pay- Back-Period (PBP)}, discounted cash flow Measures {Benefit – Cost Ratio (BCR), Net Present Value (NPV) and Internal Rate of return (IRR)} and Sensitivity analysis test as the tools to be used in answering specific objectives in this study.

2.12.1 Descriptive Statistics

Descriptive Statistics are used to describe the main features of a collection of data in quantitative terms. Descriptive statistics are distinguished from inferential statistics (or inductive Statistics), in that descriptive statistics aim to quantitatively summarise a data set, rather than being used to support inferential statements about the population that the data are thought to represent. The Descriptive statistics to be used includes; means,

percentage, variance and standard deviation

2.11.2 Simple Rate of Return (SRR)

The simple rate of return is the ratio of the profit earned by the project in a normal year of full production to the initial investment outlay. The ratio could be computed either on total investment or on equity, depending on whether one wants to know the profitability of the total investment (equity plus loans) or only the profitability of the equity capital (Pande, 2005) . The simple rates of return thus become;

$$R = \frac{P + r}{C} \times 1000$$

Where R is the simple rate of return on total investment, P the net profit in a normal year after making provisions for depreciation, interest charges and taxes, C the total investment comprising equity and loan, r the annual interest charges on loans in a normal year. The criterion for project selection is to choose the project with the highest rate of return (Gittinger, 1994). If only a single project proposal is involved, the project is accepted if the rate of return is higher than the interest rate prevailing in the capital market. The merit of the simple rate of return method is that it is straightforward to calculate as it does not involve any adjustments. Its short-coming are as follow:

- The evaluation is based on only one year's data, ignoring the rest of the project's life span
- It is difficult to determine the normal year to be taken as basis for computing the rate of return. And
- It does not take into account the timing of cash inflows and outflows during the life of the project

2.11.3 Pay-Back-Period (PBP)

The pay-back-period is another method to evaluate an investment project. The payback method focuses on the payback period. It is the length of time that it takes for e project to recoup its initial cost out of the cash receipts that it generates. This period is sometime referred to as '' the time that it takes for an investment to pay for itself" The basic premise of thee pay-back-period is the number of years it takes to recover the initial investment outlay through the profits earned by the project. Profit here refers to the net cash flow. The calculation of pay-back-period is shown in equation 2

$$\text{Pay-Back-Period (PBP)} = \frac{\text{Total Investment (Years)}}{\text{Net Cash Flow per year}} \quad \text{.....equation 2}$$

It should also be noted that: Net Cash Flow = Profit after tax + Depreciation

The criterion for project selection is to invest on the project that recovers the total investment in the shortest possible time (Gittinger, 1994). Where a single project proposal is being considered, the project is accepted if the pay-back-period is smaller or equal to a pre-determined cut-off pay-back-period established by the investor. The cut-off pay-back-period is said to derive from past experiences with similar projects.

According to **Paul, 1995**; the merit of the pay -back-period method for appraising investment project is that it is simple to calculate and easy to understand. Its shortcoming is that it ignores completely the returns that come into the business after the pay-back-period. The project that returns the capital invested in the quickest time is not necessary the most profitable project, hence this technique can sometimes lead to a wrong decision. Furthermore, the techniques fail to take into consideration the time value of money.

2.11.4 Benefit - Cost Ratio (BCR) Analysis Model

The aim of benefit-cost analysis is to provide a framework for assessing the ability of a project to offer a potential *pareto* improvement (COAG,2007). The Benefit-cost ratio is a discounted measure of project worth and is one of the tools used to in answering objective 6. It is the present worth of the benefit stream divided by the present worth of the cost stream. When the benefit-cost ratio is used, the normal selection criterion is to accept all

independent projects with a benefit-cost ratio of 1, or greater, when discounted at a suitable discount rate, most often which is the opportunity cost of capital. The BCR is mathematically expressed as shown in

equation 3

$$BCR = \frac{\sum_{t=1}^{t=n} \frac{B_t}{(1+i)^t}}{\sum_{t=1}^{t=n} \frac{B_t}{(1+i)^t}} \text{----------Equation 3}$$

Where;

B_t	=	Benefit each year
Ct	=	Cost in each year
T	=	Time period in years
I	=	Interest rate or the discount rate which is assured to remain constant over the relevant Period under review

2.11.5 Net Present Value (NPV)

The net present value (NPV) is a measure of the present worth of the incremental net benefit of an investment. It is an investment evaluation tool obtained by discounting the streams of net benefits using suitable interest rate ® and is the 2nd tool be used in answering objective 6. The rate chosen should be the opportunity cost of the funds invested (Adler, 1971 and Gittinger, 1994). The NPV measures the present worth of the benefit streams less the present worth of the cost stream. It shows the amount by which total benefits exceed total costs when both are discounted at some

specific interest rate

Mathematically, it is represented as shown in equation 4

$$NPV = \sum_{t=1}^{n} \frac{B_t}{(1+r)^t} - \sum_{t=1}^{n} \frac{C_t}{(1+r)^t} = \sum_{t=1}^{n} \frac{(B_t - C_t)}{\mathbf{(1+r)^t}} = ><0 \ldots\text{.Equation 4}$$

Where Bt = Cash inflow in period t

Ct = Cash outflow in period t

r = Discount factor corresponding to the cost of capital'.

The discount factor is being obtained from present value table and should be equal to the leading rate of the Bank or any other financial institution which the project promoters intend to use for financing the project on long-term basis.

2.11.6 The Internal Rate of Return (IRR)

This is percentage interest rate at which the present value of the costs exactly equals the present value of the benefits. In other words it is the discount rate that makes the net present worth of the incremental net benefits stream to be equal to zero. The IRR is important because it tells you exactly how hard your money is working for you. It is not misleading like many other measures of rate of return. According to Vincent (1987), the Internal Rate of Return is most usefully applied when it is not easy to determine the appropriate discount rate for computing the net present value of a project or when one is interested in knowing the rate at which

the capital invested is compounded over the project's life. The general principle is to evaluate the \IRR against some suitable rates of investment such as rates or the return earned in alternative investments (Paul, 1982; Kola, 1982 and Gittinger, 1992, 1994). If the IRR from the investment exceeds these rates, the investment is worthwhile in the sense that the investment rose per-capital income relative to what is otherwise would have been. . The mathematical formula for IRR is expressed by equation……..5

IRR = $$B_0 - C_0 + \frac{B_1 - C_1}{(1+IRR)} + \frac{B_2 - C_2}{(1+IRR)^2} + \ldots + \frac{B_t - C_t}{(1+IRR)^t} + \ldots + \frac{B_n - C_n}{(1+IRR)^n}$$ **= 0**

OR IRR = $$\sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t}$$ ***= 0 or IRR =***

NPV=0...*equation (5)*

Where:

B_t	=	Net return of period't'
C_t	=	Total estimated cost of capital items and operation costs
n	=	Number of years
t	=	Time periods in years (where t = 1, 2, n) This is the terminal end of the life span of the investment

This can be solved by a search procedure, which is available in most spreadsheet packages - such as Microsoft Excel.

IRR could also be computed using the Following Steps (Oluyomi and Igwe, 1981; Vincent, 1987) equation 5:

- A discount rate should be assumed
- The NPV should be computed at the assumed rate
- If the NPV is positive, then select a larger discount rate. If the NPV is

negative, select a lower discount rate.

- NPV should be computed until its values switches sign
- Using one positive and one negative value of NPV, The IRR can then be derived by interpolation

Mathematically Approach for Determining IRR

$$IRR = \frac{\text{Lower discount rate + (NPV at d.r) (Differences between the 2 d.rs)}}{\text{Absolute differences between NPV and the 2d.rs)}} \quad \text{...Equation 6}$$

Where d. r = discount rate
The absolute difference implies that the minus sign is neglected.

Criteria for acceptability:

NPV > 0 or IRR > the discount rate, r

The short-comings of the method are that it is cumbersome to calculate and cannot be safely applied where negative net cash flows are involved in a project's life.

2.11.7 Sensitivity Analysis Test Model:

The parameter values and assumptions of any model are subject to change and error. Sensitivity analysis (SA), broadly defined, is the investigation of these potential changes and errors and their impacts on conclusions to be drawn from the model (Baker *et al.*,1999). SA

can be easy to do, easy to understand, and easy to communicate. It is possibly the most useful and most widely used technique available to modelers who wish to support decision makers. The importance and usefulness of SA is widely recognized: It helps to pinpoint critical areas that require the attention of management in the course of operations (UNIDO, 1978), Baker *et al.*(1999) identified sensitivity analysis as one of the principal quantitative techniques used for risk management in the United Kingdom. Jones (2000) indicated that sensitivity analysis can provide the basis for planning adaptation measures to mitigate the risk of climate change. Sensitivity analysis can be used as an aid in identifying the important uncertainties for the purpose of prioritizing additional data collection or research (Cullen and Frey, 1999). Furthermore, sensitivity analysis can play an important role in model verification and validation throughout the course of model development and refinement (*e.g.*, Kleijnen, 1995; Kleijnen and Sargent, 2000; and Fraedrich and Goldberg, 2000). Sensitivity analysis also can be used to provide insight into the robustness of model results when making decisions (*e.g.,* Phillips *et al.*, 2000; Ward and Carpenter 1996; Limat *et al.*, 2000; Manheim 1998; and Saltelli *et al.*, 2000). Sensitivity analysis methods have been applied in various fields including complex engineering systems,

economics, physics, social sciences, medical decision making, and others (*e.g.*, Oh and Yang, 2000; Baniotopoulos, 1991; Helton and Breeding, 1993; Cheng, 1991; Beck *et al.*, 1997; Agro *et al.*, 1997; Kewley *et al.*, 2000; Merz *et al.*, 1992). Other literatures on sensitivity analysis and outlier detection; for example, the books by Hawkins (1980), Cook and Weisberg (1982), Chatterjee and Hadi (1988), and Barnett and Lewis (1994); the papers by Cook (1977, 1986), Gray (1986), Paul and Fung (1991), Schwarzmann (1991), Nyquist (1992), Hadi and Simonoff (1993), Billor *et al.* (2001), And Winsnowski *et al.* (2001).

Sensitivity analysis methods can be classified in a variety of ways: (i) mathematical; (ii) statistical; and (iii) graphical. Other classifications focus on the capability, rather than the methodology, of a specific technique (*e.g.*, Saltelli *et al.*, 2000). Here, the focus is on sensitivity analysis techniques applied in a mathematical method. Mathematical methods assess sensitivity of a model output to the range of variation of an input. These methods typically involve calculating the output for a few values of an input that represent the possible range of the input (*e.g.*, Salehi *et al.*, 2000). These methods do not address the variance in the output due to the variance in the inputs, but they can assess the impact of range of variation in the input values on the output (Morgan and Henrion, 1990). In some

cases, mathematical methods can be helpful in screening the most important inputs (*e.g.*, Brun *et al.*,2001). These methods also can be used for verification and validation (*e.g.*, Wotawa *et al.*, 1997) and to identify inputs that require further data acquisition or research (*e.g.*, Ariens *et al.*, 2000). Mathematical methods evaluated here include nominal range sensitivity analysis (Changes in cost of production and decline in prices of output), use of Sensitivity Indicators and Switching Values on Net Present Value (NPV) and Internal Rate of Return (IRR), is the major concern in this study. Sensitivity Indicators for NPV Compares percentage change in NPV with percentage change in a variable or combination of variables, while Sensitivity Indicators for IRR Compares percentage change in IRR above the cut-off rate (Frey and Patil, 2002)., switching values (SV) for NPV is the percentage change in a variable or combination of variables to reduce the NPV to zero (0). Whereas switching value for IRR is the percentage change in a variable or combination of variables to reduce the IRR to the cut-off rate (=discount rate). Sensitivity indicators (SI) and switching values (SV) can be calculated for IRR and NPV, as indicated below (Saltelli et al., 2000) Calculation of Sensitivity Indicator (SI) towards NPV and IRR;

$$\text{(i). SI (NPV)} = \frac{(NPV_b - NPV_1) / NPV_b}{(X_b - X_1) / X_b}$$

where:

X_b - value of variable in the base case

X_1 - value of the variable in the sensitivity test
NPV_b - value of NPV in the base case
NPV_1 - value of the variable in the sensitivity test

Criteria: the higher the SI, the more sensitive the NPV is to the change in the concerned variable.

$$\text{(ii).} \quad SI(IRR) = \frac{IRR_b - IRR_1) / (IRR_b - d)}{(Xb - X1) / Xb}$$

where:
X_b - value of variable in the base case
X_1 - value of the variable in the sensitivity test
IRR_b - value of IRR in the base case
IRR_1 - Value of the variable in the sensitivity test
d - discount rate

Criteria: the higher the SI, the more sensitive the IRR is to the change in the concerned variable.

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Calculation of switching values (SV) for NPV and IRR

$$\text{i. } SV(NPV) = \frac{(100 \times NPV_b)}{(NPV_b - NPV_1)} \times \frac{(X_b - X_1)}{X_b}$$

where:
X_b - value of variable in the base case
X_1 - value of the variable in the sensitivity test
NPV_b – value of NPV in the base case
NPV_1 – value of the variable in the sensitivity test

Criteria: The lower the SV, the more sensitive the NPV is to the change in the variable concerned and the higher the risk with the project

$$SV(IRR) = \frac{(IRR)\,(100 \times (IRR_b - d)}{(IRR_b - IRR_1)} \times \frac{(X_b - X_1)}{X_b}$$

where:

X_b - value of variable in the base case
X_1 - value of the variable in the sensitivity test
IRR_b - value of IRR in the base case
IRR_1 – value of the variable in the sensitivity test
d - discount rate

Criteria: for acceptability of a project, the SV for IRR should be higher than the discount rate or interest used

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CHAPTER THREE

3.0 METHODOLOGY

The aspects of methodology highlighted are study areas, sampling procedure, data requirements, method of data collection and analytical techniques.

3.1 Study Areas

Study was carried out in five villages in five states of Nigeria – A Village per state each (i). Baizare in Kaduna State –geographical coordinates; latitude 09^0 02′ 5″ North and longitude 6^0 19′ 0″ East. (ii). Sara in Jigawa State – latitude 10° 29' 2" North, and longitude 9^0 26′ 6″ East. (iii). Kona-Mada in FCT- Abuja ,latitude of 9.083 and longitude of 7.532. (iv). Gbajigi – Bida in Niger State , latitude 9^0 43′ 3″ North and longitude 5^0 45′ 1″ East and (v). Omor in Anambra State, latitude 4^0 44′ 19″ North and longitude 6^0 50′ 1″ East). Figure 3.1 shows the states where the villages for brown sugar mini-processing firms were located, with their capitals indicated by dots.



Fig. 3.1: Map of Nigeria Showing the States where Brown Sugar Firms were Located

The Villages where the brown sugar mini-processing firms are located produce other crops like yam, cassava, rice among others. They have rivers, and their tributaries that supply water to the community for their farming in dry seasons and for domestic use. About two hundred hectares were said to have been cropped to sugarcane in these selected areas (NCRI, 2002). The soils are vertisols, sandy with heavy alluvial deposits. Which could be described as hydromorphic in nature and moist almost the

year round and thus, greatly supports sugarcane production? The areas are easily accessible through tarred roads, and most of their major markets are not far from the brown sugar mini-processing firms. Transportation is usually not a problem as vehicles of all kinds are available most especially on market days

3.2 Sampling Techniques. A reconnaissance survey, which is useful to obtain a more detailed picture of the project areas, was undertaken. During the survey, technical and non-technical data were collected from the State Ministries of Agriculture/ ADPS of the five States, and also from the farmers and the brown sugar processors. A total of five Hundred and forty-five (545) sugarcane farmers were identified (95 from Baizare in Kaduna State, 144 from Sara in Jigawa State, 120 from Konar-Mada in FCT Abuja, 130 from Gbajigi in Niger State and 56 from Omor in Anambra State) and five (5) brown sugar Mini-Processing firms located at; Baizare village – Zaria in Kaduna State, Sara in Jigawa State, Konar-Mada in FCT Abuja, Gbajigi in Niger and Omor village in Anambra state were identified as population size or sample frame. For this study, Thirty percent (30%) of the identified sample frame was used as sample size. Simple random sampling method was applied in selecting 163 sugarcane farmers across the locations (28 from Bazaire, 43 from Sara, 36 from konar-Mada, 39 from Gbajigi and 17 from Omor). This is to give equal chance of appearing in the selection for the sugar cane farmers and to sure that such decision is not made by an

investigator on his will but selection of units is left on chance. The advantage of this method is that it is free from personal bias and the use of this technique saves time, money and labour.

A purposive sampling technique was used for the 5 brown sugar mini-processing firms selected. Here, the investigator exercised his judgement in the choice and includes those items in the sample which he thinks are most typical of the universe with regard to the characteristics under study. There was greater chance of the investigator's own prejudice in this method

3.3 Methods of Data Collection

The study relied on both primary and secondary data collected in order to have enough information to achieve the objectives. Primary data were collected using a set of survey questionnaires administered on 163 sugar cane farmers across the locations on:-

- the availability of sugarcane cultivable land and farm sizes under sugarcane cultivation
- yield of sugarcane per hectare and,
- on total farm size put into sugar cane production within the brown sugar cottage firm sited areas.

Similarly sets of questionnaires were administered on brown sugar processors on;-

- the general cost of the plant
- building and installment/test running
- quantity of raw materials (other inputs) and their cost

- Prices of the expected product and,
- Staff requirement.

Secondary data were obtained from The Ministry of Agriculture and Rural Development / Agricultural Development Projects (ADPs) in the five states, research reports, libraries, National Sugar Development Council (NSDC) Abuja, National Bureau of Statistics Office-Abuja, Bacita Sugar Company, Savannah Sugar Company, Numan, journals, Federal Ministry of Agriculture, internets and other documents that are relevant to the study

3.4 ANALYTICAL TECHNIQUES USED

The analytical techniques used to achieve the specific objectives of the study include; (1) descriptive statistics, (2) Undiscounted, (3) discounted cash flow Measures and (4) Sensitivity analysis test.

3.4.1 Descriptive statistics

Descriptive statistics like used include means, percentage, variance and standard deviation were implored in analyzing objectives (i) and (ii),

3.4.2 Undiscounted Cash flow measures.

3.4.2.1 Simple Rate of Return

$$SRR = \frac{P}{C} \times 100 \quad \text{.....equation (1)}$$

Where:

SRR = is the simple rate of return on total investment
P = The net profit in a normal year after making provisions for depreciation, interest charges and taxes

C = the total investment cost, comprising equity and loans

This was used in evaluating objective (ii)

3.4.2.2 Pay- Back-Period (PBP)

$$\text{Pay- Back -Period (PBP)} = \frac{\text{The Costs of Project / initial Investment}}{\text{Annual Cash Inflows}} \quad \text{.....Equation (2)}$$

It is also easily applied in spreadsheets. It was used examining objective (v)

3.4.3 Discounted Cash flows measures

Discounted cash flow measures are however, the most accepted criteria of investment analysis (Gittinger, 1994). Such cash flows measures include; (i) Benefit-Cost Ratio BCR), (ii) the Net Present Value (NPV) and (iii) the Internal Rate of Return (IRR).

3.4.3.1 Benefit - Cost Ratio

$$\textbf{BCR} = \frac{\sum_{t=1}^{t=n} \frac{B_t}{(1+i)^t}}{\sum_{t=1}^{t=n} \frac{C_t}{(1+i)^t}} \quad \text{----------Equation (3)}$$

Where;

B_t = Benefit each year
Ct = Cost in each year
T = Time period in years
I = Interest rate or the discount rate which is assured to remain constant over the relevant Period under reviewed.

It was the 1st tool used in analyzing objective (vi)..

3.4.3.2 The Net Present Value (NPV)

NPV = $$B_0 - C_0 + \frac{B_1 - C_1}{(1+r)} + \frac{B_2 - C_2}{(1+r)^2} + \ldots + \frac{B_t - C_t}{(1+r)^t} + \ldots + \frac{B_n - C_n}{(1+r)^n}$$

$$= \sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t} \qquad \text{.....Equation (4)}$$

Where:

B_t =the benefits in year t,
C_t = are the costs in year t,
r = is the discount rate, and
n = is the horizon year.

- $\frac{1}{(1+r)^t}$ *is called the discount factor in Year t.*

Note that if Present Value of Benefits (PVB) is the sum of the discounted benefit stream, $\sum_{t=0}^{n} \frac{B_t}{(1+r)^t}$ *, and Present Value of Costs (PVC) is the sum of the discounted cost stream,* $\sum_{t=0}^{n} \frac{C_t}{(1+r)^t}$ *,*

then NPV = PVB – PVC.

$$NPV = \sum_{t=1}^{n} \frac{B_t}{(1+r)^t} - \sum_{t=1}^{n} \frac{C_t}{(1+r)^t} = \sum_{t=1}^{n} \frac{(B_t - C_t)}{(1+r)^t} \quad >< 0$$

Where:

B_t = Cash inflow in period t

C_t = Cash outflow in period t

r = Discount factor corresponding to the cost of capital'.

The NPV can be calculated using spreadsheet software such as Microsoft Excel, most of which conveniently have an NPV function built-in.

The Net Present Value (NPV) was the 2nd tool used in analyzing part of objective (vi).

3.4.3.3 The Internal Rate Return (IRR)

IRR = $B_0 - C_0 + \frac{B_1 - C_1}{(1+IRR)} + \frac{B_2 - C_2}{(1+IRR)^2} + \ldots + \frac{B_t - C_t}{(1+IRR)^t} + \ldots + \frac{B_n - C_n}{(1+IRR)^n}$ **= 0**

OR IRR = $\sum_{t=0}^{n} \frac{B_t - C_t}{(1+r)^t}$ ***= 0 or IRR = NPV=0…****equation (5)*

Where:

B_t	=	Net return of period't'
C_t	=	Total estimated cost of capital items and operation costs
n	=	Number of years
t	=	Time periods in years (where t = 1, 2, n) This is the terminal end of the life span of the investment

Criteria for acceptability:NPV > 0 or IRR > the discount rate, r

This can be solved by a search procedure, which is available in most spreadsheet packages - such as Microsoft Excel. It was the 3rd tool used realizing objective (vi).

3.4.4 Sensitivity Analysis Test

The importance and usefulness of Sensitivity Analysis (SA) is widely recognized. In this study, it is used to assess sensitivity of a model output to the range of variation of an inputs (10% and 20% increases in investment cost / decline in revenue) - calculated using Microsoft Excel spreed sheet, and to evaluate its sensitivity indicators (SI) and switching values (SV). Sensitivity indicators (SI) and switching (SV) under sensitivity analysis test can be calculated for IRR and NPV, as indicated below (Saltelli et al., 2000)

$$\text{(i). SI (NPV)} = \frac{(NPV_b - NPV_1) / NPV_b}{(X_b - X_1) / X_b}$$

where:
X_b - value of variable in the base case
X_1 - value of the variable in the sensitivity test
NPV_b - value of NPV in the base case
NPV_1 - value of the variable in the sensitivity test

Criteria: the higher the SI, the more sensitive the NPV is to the change in the concerned variable.

$$\text{(ii). SI (IRR)} = \frac{IRR_b - IRR_1) / (IRR_b - d)}{(Xb - X1) / Xb}$$

where:
X_b - value of variable in the base case
X_1 - value of the variable in the sensitivity test
IRR_b - value of IRR in the base case
IRR_1 - Value of the variable in the sensitivity test
d - discount rate

Criteria: the higher the SI, the more sensitive the IRR is to the change in the Cncerned variable.

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Calculation of switching values (SV) for NPV and IRR

$$\text{i. SV(NPV)} = \frac{(100 \times NPV_b)}{(NPV_b - NPV_1)} \times \frac{(X_b - X_1)}{X_b}$$

where:
X_b - value of variable in the base case
X_1 - value of the variable in the sensitivity test
NPV_b – value of NPV in the base case
NPV_1 – value of the variable in the sensitivity test

Criteria: The lower the SV, the more sensitive the NPV is to the change in the variable concerned and the higher the risk with the project

$$SV\ (IRR) = \frac{(IRR)\ (100 \times (IRR_b - d)}{(IRR_b - IRR_1)} \times \frac{(X_b - X_1)}{X_b}$$

where:
X_b - value of variable in the base case
X_1 - value of the variable in the sensitivity test
IRR_b - value of IRR in the base case
IRR_1 – value of the variable in the sensitivity test
d - discount rate

Criteria: for acceptability of a project, the SV for IRR should be higher than the discount rate or interest used

Sensitivity Analysis Test (SAT) was used in analyzing objective (vii) of the study

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This section presents the results and discussion on the analysed data. There are arranged subsequently in the order of the objectives; Sugarcane land availability, average yield per hectare of sugarcane in the studied areas, simple rate of return of 10 tonnes crushing per day (TCD) of mini-brown sugar processing firm, Pay –Back-Period (PBP) for the brown sugar mini-processing firm, Benefit – Cost Ratio (BCR), Net Present Value (NPV) and the Internal Rate of Return (IRR) of investment in brown sugar mini-processing industry and What happened to return on investment in the brown sugar mini-processing firm as a results of increased in costs of production or decline in the price of the product(s) .

4.1 Sugarcane land availability in Nigeria.

Data made available from the National Cereals Research institute, Badeggi, which has national mandate on sugarcane genetic improvement and production techniques, shows that more than 250,000 hectares of land is available in Nigeria for sugarcane production (NCRI, 2002). The major sugarcane producing communities in the country are shown in Table 4.1.

Table 4.1: List of Major Sugarcane Producing Communities/Available Land for Production

S/No.	Community	State	Available sugarcane production land (Ha)
1	Bende	Abia	300
2	Igberre	,,	200
3	Lau	Adamawa	10,000
4	Numan	,,	20,000
5	Ganye	,,	200
6	Kafin-Hausa	,,	150
7	Magar	,,	120
8	Mayo-Inne	,,	9,000
9	Uyo	Akwa-Ibom	200
10	Anambra-Do	Anambra	1,500
11	Omor	‘’,	300
12	Yenagoa	Bayelsa	100
13	Baisara	Benue,	5,000
14	Zarama	,,	7,000
15	Obubra	Cross-River	1,000
16	Ake-Eze	Ebonyi	7,500
17	Afuze	Edo	3,000
18	Alera	,,	5,000
19	Agbenebode-Ilu	,,	7,500
20	Yaba (Konar-Mada)	FCT-Abuja	200
21	Ulona	Imo	5,000
22	Hadijia	Jigawa	8,000
23	Malamawa	,,	800
24	Sitaye Kiyama	,,	1,300
25	Sara	,,	350
26	Rogo	Kano	300
27	Tomas	,,	600
28	Yakarade	,,	200
29	Birnin-Kebbi	Kebbi	300
30	Anchau	Kaduna	2,500
31	Baizare	,,	1200
32	Dawarta	,,	350
33	Dutsen-Wai	,,	500
34	Jagindi	,,	400
35	Kagoro	,,	500
36	Makarfi	,,	800
37	Takalafiya	Katsina	300
38	Danja	,,	350

39	Malumfashi	,,	300
40	Tanama	Kwara	150
41	Ayangba	,,	12,500
42	Idah	Niger	5,000
43	Bacita	,,	12,500
44	Lafiagi	,,	10,000
45	Agie	,,	300
46	Mokwa	,,	700
47	Illuchi	,,	500
48	Gbakogi	,,	6,000
49	Jima	,,	250
50	Goga	Niger	100
51	Ndagbachi	,,	300
52	Sunti	,,	1,000
53	Wuya-suman	Ogun	1,000
54	Edozhigi	,,	1,200
55	Bida	,,	500
56	Ifo	Ondo	300
57	Otta		750
58	Papa-Lanto		300
	Okitipupa		200
59	Iyansan	,,	7,000
60	Ede	Osun	500
61	Ogbomosho	Oyo	350
62	Oyo	Oyo	200
63	Mada	Plateau	800
64	Shemankar	,,	1,000
65	Ibaa	Rivers	200
67	Bakolori	Sokoto	5,000
68	Binji	,,	300
69	Binji-Musa	,,	250
70	Goronyo	,,	2,500
71	Hanake	,,	400
72	Kware	,,	300
73	Wurno	,,	2,000
74	Donga	Taraba	500
75	Gassol	,,	8,000
	Total		**183, 970**

Source: Adopted from NCRI, Badeggi: Survey on sugarcane Land available in Nigeria, 2002.

This information which was adapted from NCRI, Badeggi has shown that land is not a hindrance to sugarcane production Nigeria.

4.2 Yield per Hectare Recorded across the Study Areas

A pooled data of an average of 55 tonnes/ha with a standard error of 3.21 at 5% level of significance have been recorded across the five location as indicated in the Table 4.2. Highest average yield of 59 tonnes/ha was recorded in Sara village of Jigawa State and a lowest average yield per hectare of 42.2 tonnes recorded in Omor village of Anmabra State. These results indicated that the areas where the brown sugar mini-processing machines have been sited are favourable for sugarcane production. Sugarcane output per hectare from Sugarcane research institutes shows that an average yield of 60-70 tonnes/ hectare are optimal (NCRI, 2008). The farmers were however complaining of lack of fund to enable them use their available land effectively. Some are also eager to have their on Brown sugar mini-processing firms, if loan can be given by financial institutions.

Table 4.2: Yield per Hectare Recorded across the Studied Sites

Respondents	Omor-Anambra State (t/ha)	Konar-Mada FCT(t/ha)	Zaria - Kaduna State(t/ha)	Sara-Jiigawa State(t/ha)	Gbajigi-Niger State(t/ha)	Pooled Average yield per hectare across the studied sites (t/ha)
1	32	50	67	75	70	58.8
2	40	65	65	70	40	56
3	50	70	50	56	75	60.2
4	40	60	55	48	55	51.6
5	35	63	47	55	50	50
6	50	60	48	45	45	49.6
7	45	50	45	46	65	50.2
8	50	46	40	58	60	56.8
9	39	48	45	70	70	54.4
10	45	50	85	85	50	63

Respondents	Omor-Anambra State (t/ha)	Konar-Mada FCT(t/ha)	Zaria - Kaduna State(t/ha)	Sara-Jiigawa State(t/ha)	Gbajigi-Niger State(t/ha)	Pooled Average yield per hectare across the studied sites (t/ha)
12	42	65	65	70	53	59
13	50	70	45	65	46	55.5
14	30	85	50	50	48	52.6
15	48	80	55	50	67	60
16	40	70	60	55	58	56.6
17	37	72	56	60	53	55.6
18	45	70	65	45	62	57.4
20		45	75	43	70	58.3
21		40	50	40	48	44.5
22		45	60	60	58	55.3
23		38	67	65	65	58.8
24		48	60	62	32	50.5
25		50	45	68	55	54.5
26		48	56	40.5	67	52.9
27		55	54	55.5	73	59.4
28		65	55	47	65	58.5
29		64	48	49	64	53.3
30		63		65	63	63.6
31		48		60	48	52
32		78		65	56	66.3
33		60		64	54	59.5
34		55		48	52	59
35		54		49	65	57
36		48		75	56	55.5
37				68	50	59
38				56	58	57
39				49	62	55
40				59		59
41				65		65
42				67		67
43				48		48
Mean yield	42.2	58.58	57.34	58.87	57.87	54.81
Std Error	1.18	2.61	2.34	2.64	45	
Minimum	30	38	40	40	32	
Maximum	50	85	85	90	75	

Source: 2009/2010 Survey data, Financial Feasibility study on Five Brown Sugar Mini-Processing Firms in Nigeria

4.3 Simple Rate of Return

Simple rate of return method is a capital budgeting technique that was used to achieve objective iii.; the parameters or factors used in calculating simple rate of return and the subsequent models include:

i. Total number of firm/factory working days per annum (i.e crushing season) for income and expenditure is 150 days (5 months from November to march)

ii. Plant capacity is 10 tcd , therefore factory/firm were to process 10 x 150 tonnes (i.e 1500 tonnes) each in one season.

iii. Sugarcane supplied was for 150 days i.e 1500 tonnes at the rate of ₦3,000 per tonne in Sara of Jigawa State, Zaria in Kaduna State, Gbajigi in Niger State and Konar- mada in FCT- Abuja, while it was at ₦4,000 per tonne in Omor-Anambra State

iv. Processing costs and prices of each product are very conservative and based on current market price (Brown sugar @ ₦164 per Kilogram (Kg) and at ₦120/ kg).

v. Provision was made for all minor inputs – Okra, firewood, packaging materials and water, Electricity and fuel for transportation - in the estimation of Annual expenditure.

vi. The total strength of staff was 13; this consisted of eight (8) permanent staff and 5 part- time Staff on commensurate salaries which have been negotiated by the processors based on the prevailing economic realities.

vii. Depreciation is calculated on the fixed costs (Land, building, plant and Machinery) using a straight line method.

viii. The projected life span of the project is 10 years

ix. The enterprise were said to enjoy a tax free holiday for the first five years

arising from its Pioneer *status.*

x. The processors obtained bank loan at an interest rate of 25%.

Tables 4.3 and 4.4 presents the total establishment cost and the revenue generated for a full year (five Months) operation respectively of the studied brown sugar mini - processing firms. This is to aid in the calculation of the simple rate of return (SRR) and the subsequent analytical models.

The results which are conveyed in Table 4.5 shows that the pooled data have 64% simple rate of return, while 45%, 49%,63%, 69% and 63% for Omor-Anambra State, Konar-Mada, FCT-Abuja, Zaria- Kaduna State, Sara - Jigawa State and Gbajigi-Bida Niger State respectively. All the results of the simple rate of return across the sites were higher than the interest rating prevailing (25%) in the capital market (2009), which should be accepted as per the criteria for acceptance of projects.

Table 4.3: **Project Establishment Costs across the Five Sites of the Brown Sugar – Mini Processing Firms**

S/No.	Activities/Items	Omor- Anambara State (₦)	Konar-Mada FCT-Abuja (₦)	Zaria, Kaduna State (₦)	Sara, Jigawa State (₦)	Gbajigi-Bida, Niger State (₦)	Pooled Data Cost (₦)
A.	Land, building and External works	2,150,000	1,650,000	1,650,000	1,650,000	1,650,000	1,750,000
	Machinery and Equipments	3,614,000	3,614,000	3,614,000	3,614,000	3,614,000	3,614,000
	Pick-up Van	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000	1,500,000
	Stand-by-Generator	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000	4,500,000
	Installation, Commissioning/ Training	250,000	180,000	200,000	220,000	120,000	194,000
	Pre-investment	150,000	100,000	100,000	100,000	100,000	100,000
	Contingency (5%)	608,200	577,200	578,200	579,200	574,200	582,900
	Sub-Total	**12,772,200**	**12,127,200**	**12,142,200**	**12,163,200**	**12,058,200**	**12,240,900**
B.	**Personnel Wages and Allowances**	13					
		300,000					
	Total staff strength	180,000	13	13	13	13	13
	1No. Factory manager/supervisor (21000 X 12) =	240,000	240,000	240,000	240,000	240,000	252,000
	1No. Accounts/Sales clerk (8,600X12) =	168,000	84,000	84,000	84,000	84,000	103,000
	2 Nos. Mechanical/ Electrical Operators (6,000 x2x12)	84,000	144,000	144,000	144,000	144,000	165,200
	2Nos. Security guards (5,400X2X12 months		120,000	120,000	120,000	120,000	129,600
	1No. Messenger/Cleaner (5,400X12 months)		60,000	60,000	60,000	60,000	64,800
	6 Nos. casual Workers (lump sum for 5 months (6 X5,400X5	210,000					
	Sub-total	**1,182,000**					
C.		108,000	162,000	162,000	162,000	162,000	171,600
		108,000	**810,000**	**810,000**	**810,000**	**810,000**	**884,400**
	Utilities and Maintenance	504,000					
	Electricity - (N260 X30 days x12)	**720,000**	90,000	90,000	90,000	90,000	93,600
	Water - (N140 X30 days X 12		36,000	36,000	36,000	36,000	50,400
	Fuel - (20 L X 70 x 30 days x 12		504,000	504,000	504,000	504,000	504,000
			630,000	**630,000**	**630,000**	**630,000**	**648,000**

D.							
		6,000,000					
		200,000					
	Raw and Packaging materials	150,000	4,500,000	4,500,000	4,500,000	4,500,000	4,800,000
	Sugarcane (10 tonnes X 150days x N3,200/tonne	100,000	200,000	200,000	200,000	200,000	200,000
E.	polythene packages and plastic drums –lump sum	**6,350,000**	150,000	150,000	150,000	150,000	150,000
	Labelling (logo printing in packages- lump sum	100,000	100,000	100,000	100,000	100,000	100,000
	Firewood, okra, etc		**4,950,000**	**4,950**,000	**4,950,000**	**4,950,000**	**5,250,000**
			100,000	100,000	100,000	100,000	100,000
F	**Miscellaneous Expenses**						
		1,182,000					
		720,000					
		6,350,000					
		100.000		810,000	810,000	810,000	884,400
	Total Annual working capital (summary)	8,352,000	810,000	630,000	630,000	630,000	648,000
	personnel wages and allowances		630,000	4,950,000	4,950,000	4,950,000	5,230,000
	Utilities and Maintenance		4,950,000	100,000	100,000	100,000	100,000
	raw materials and other inputs		100,000	**6,490,000**	**6,490,000**	**6,490,000**	**6,862,400**
G.	Miscellaneous Expenses		**6,490,000**				
	Total Annual working capital (summary)						
	Total Investment Cost = Project Establishment cost + Total Annual Working Capital	**21,124,200**	**18,611,200**	**18,596,200**	**18,617,200**	**18,512,200**	**19,103,300**

Source: 2009/2010 Survey data, Financial Feasibility study on Five Brown Sugar Mini-Processing Firms in Nigeria

Note:

Difference in cost of the Mini brown sugar processing plant has been observed in Omor-Anambra state, while the cost are similar in other studied sites
for Example: The prices of sugarcane/tonne was N4,000 in Omor-Anambra State, while it was N3000/tonne in other studied sites. The salaries and wages of workers also differed in Omor – Anmabra State compared to the other four locations)

Table 4.4: Sources / Revenue Generated for one Year full Operation across the Sites

S/No.	Brown Sugar Minn—Processing Firms Location	Revenue Source (s)	Tonnes/Year	₦/Tonne	Value per Year (₦)	Total Revenue / Year (₦)
1	Omor -Anambra State	Brown Sugar (crystal)	73	164,000	11,972,000	22,692,0000
		Liquid Sugar (mollasses)	89.3	120,000	10,720,000	
2	Konar-Mada, FCT-Abuja	Brown Sugar (crystal)				
		Liquid Sugar (mollasses)	68	164,000	11,152,000	19,552,000
3	Bazaire-Zaria, Kaduna State	Brown Sugar (crystal)	70	120,000	8,400,000	
		Liquid Sugar (mollasses)	75	164,000	12,300,000	
4	Sara, Jigawa State	Brown Sugar (crystal)	82	120,000	9,840,000	22,140,000
		Liquid Sugar (mollasses)	82	164,000	13,448,000	
5	Gbajigi-Bida, Niger State	Brown Sugar (crystal)	82.3	120,000	9,876,000	23,324,000
		Liquid Sugar (mollasses)	72	164,000	11,808,000	
6	Pooled Data		87	120,000	10,440,000	22,248,000
		Brown Sugar (crystal)	74	164,000	12,136,000	
		Liquid Sugar (mollasses)	82.12	120,000	9,854,400	21,990,400

Source: 2009/2010 Survey data, Financial Feasibility study on Five Brown Sugar Mini-Processing Firms in Nigeria

Table 4.5: Simple Rate of Return of the project across the sites

(a) S/No	(b) Brown Sugar Mini-Processing Firms Location (	(c) Total Investment cost (₦)	(d) Annual Net profit (₦)	(e) Simple Rate of Return _R (d) /(c) X100
1	Omor-Anambra State	21,224,200	10,974,738	52%
2	Konar-Mada FCT-Abuja	18,611,200	10,233,680	55%
3	Zaria, Kaduna State	18,596,200	13, 001,680	70%
4	Sara, Jigawa State	18,617,200	14,005,680	75%
5	Gbajigi-Bida, Niger State	18,512,200	12,929,680	70%
6	Pooled Data	19,103,300	12,229,092	64%

Source: 2009/2010 Survey data, Financial Feasibility study on Five Brown Sugar Mini-Processing Firms in Nigeria

Note: Net Profit in a normal year = Total revenue – { operation costs

+ interest charged (25%) + Depreciation- a straight line depreciation method is used for the fixed cost},

4.4 Inputs for Mini- Brown Sugar Processing Firm

This section accomplished objective 5 of the study. The major inputs for brown sugar processing firm were ; –

a. The plant layout:

i. Sugarcane Off-loading Area

ii. Sugarcane Milling Area

iii. Bagasse Drying Area

iv. Boiling Area

v. Finishing area

vi. Packaging area and store

vii. Two Main Offices

b. The Machinery-

i. Sugarcane Cutter

ii. Juice Expeller

iii. Open Pan Evaporating System

iv. Crystallizer

v. Centrifuge and

vi. Dryer

c. Other Miscellaneous Equipments are:

i. Wieghing scale

ii. Bags and polythene scalers

iii. Refractometer

iv. Plastic drums, buckets and trolleys

d. Sugarcane (raw material)

e. Okro-back extract (raw material)

f. Manpower:

i. Manager
ii. Account / sales clerk
iii.Skilled artisan / Machine Operators
iv. Messenger / Security gaurds
v. Unskilled labour

g. Infrastructural Facilities:

i. Good access road to the project site

ii. Borehole for water supply to the project

iii.Electricity supply through national Grid or

power geneating set (75-100 KVA)

4.4 .1 : PLANT LAYOUT

The small scale mini - brown sugar processing firm layout has seven (7) main work areas.

4.4.1.1 Sugarcane off loading Area: This was the area where sugarcane supplied by farmers in trucks, carts and trolleys are unloaded and weighed. It is a cleaned field space of about 25m x 25m located adjacent to the cane milling area.

4.4. 1.2 Sugarcane Milling Area: The milling bay consists of a raised concrete Platform on which the juice extractors are placed and from which pipes carrying the extracted juice was run into the boiling area after passing through a muslin cloth screen to remove debris and bagacillo. The raised platform ensures that the bagasse produced during cane milling falls freely and are collected later for drying on a large held space adjacent to the milling area.

4.4.1.3 Bagasse Drying Area: This was a 50m x 100M open area located behind the milling bay. This area is also easily accessible to the boiling area where most of the bagasse was utilized as heat energy in the underground furnace.

4.4.1.4 Boiling Area: The boiling area houses the two rows of juice evaporation Pans and the underground furnace equipped with external chimney.

4.4.1.5 Finishing section: This section accommodates the crystallizer, centrifuge, drying slab and rotary dryer where necessary

4.4.1.6 Packaging Area and Store: This was the section of the factory where dried sugar is packaged into various sizes and stored. The area is equipped with air Ventilating system.

4.4.1.7 Two main offices: Two main offices are provided for the factory manager/ supervisor and skilled artisans.

4.4.2 The Machiinery and Performance Parameters

4.4.2.1 Sugarcane cutter :

function of the cane cutter is to cut the canes stalks transversely into small fragments of 30m – 50mm lengthwise. It is composed of a horizontal shaft carrying 75 knives (blades). A trapezoidal hopper capable of accommodating sugarcane lengths of 1800mm is provided at the top of an upper solid concave. A canehopper conveyor assembly which transports the cut fragments of canes that pass through the concave screen is incorporated with the aid of solid stainless steel housing suspended by four (4) spring flat iron bars and hinged to an eccentric reciprocatory unit. A 10hp electric motor supplies power to the rotating knife assembly with the aid of appropriate pulleys and belts (plate. 1)



Plate. 4.1: Sugarcane cutter

About 5 – 6 stalks of sugarcane measuring at least 1000mm are thrown intermittently into the cane cutter through the hopper at intervals of about 10 seconds after putting on the machine for 2 minutes. The high speed rotating knives (1650rpm) cut the sugar cane into fragments of 30 – 50mm lengthwise where they are swept through a concave screen that is placed below the blade assembly onto the tray platform of the reciprocating unit. The cane fragments are transported downward and discharged into the expeller.

4.4.2.2.The Juice Expeller:

This was made up of a screw worm taping from a diameter of 80mm to 1500mm which is caged in a barrel constructed with 16mm square rods having predetermined clearances between them to allow free flow of the extracted cane juice (plate 2). A rotary pressure adjustment device is attached to the rear of the worm while the front of the worm is connected to a 25hp electric motor through a speed reduction gear

mechanism, pulleys and belts.



Plate.4. 2: Juice Expeller Machine

These fragments are subjected to very high pressure with the aid of the rotating worm. This causes the juice from the canes to be squeezed out through the clearances between the square bars and channeled into the open pan boilers through plastic pipes while the baggasse are pushed further and discharged at the front opening of the barrel. The efficiency of the sugarcane juice extraction system is about 98% (NCRI, 2008) . The capacity of the system was about 5000kg per day. Minimal loss of sugarcane (0.001%) in the sugarcane cutter is also recoverable by gathering them and re-introducing them into the machine. No loss of cane juice in the expeller. Bagasse temperature is as high as 60-65%:

4.4.2.3 Sugarcane Juice Evaporation System :

This system composed of open surface pans of about 1400mm diameter, 250mm

height and 100mm height conical base (Plate. 3). For a 10 tonness cane per day sugarcane processing plant, two (2) sets of three (3) pans each are provided. These pans are placed over an inclined underground firing tunnel having chimney for flue gas to exit into the atmosphere. A firing section constructed with angle irons that accommodates combustion of bagasse to produce very high temperatures of over 100^{o}C is provided at the entrance of the tunnel.

A vertical wall of 2.5m height made of cement blocks is provided to separate the firing chamber from the juice boiling section. This wall also acts as barrier for the air draft to be directed into the firing chamber.



Plate.4. 3: Open pan evaporating system

Extracted cane juice that is channeled through the plastic pipes into the three (3) open pans is heated up with the aid of bagasse at the combustion chamber. The juice is continuously stirred by lifting up and dropping it with the aid of long armed big

spoons of 300m diameter. This stirring accelerates the evaporation process as more body of the juice is exposed to the ambient air and exchanges heat with each other. This operation continues until the concentration of the syrup reaches 80^{o} brix. Usually, the content of the first pan which receives more intense heat is evacuated first and the content of the second one is emptied into the first, while the third content is emptied into the second pan e.t.c. The capacity of each evaporation pan is 350 liters. There is minimal sugar calamerization. There is efficient heat utilization in the underground tunnel.

4.4.2.4 Crystallizer

This equipment was used to accelerate crystal formation in the concentrated syrup (Plate 4). It is a u – shaped trough having baffles. It accommodates the concentrated hot syrup from the pans. It rotates at 1 rpm. The slow rotation of the baffles makes the hot syrup from the evaporation system to exchange heat with the ambient air thus enhancing crystallization. A discharge outlet for the crystallized syrup or massercuit is released through two (2) discharge outlets at the bottom of the trough.



Plate.4. 4: Cyrstallizer

The hot concentrated syrup at 100^{o}C is evacuated from the evaporation system and introduced into the crystallizer, while the machine is put on. The content is left in the machine for over 48hrs before the content is discharged.

The crystallizer has a capacity of 1500 litres per batch. Its crystallization efficiency is over 85% (NCRI, 2008).

4.4.2.5 Centrifuge

The centrifuge was used in separating sugar crystals from the molasses after crystallization. It is mainly composed of an inner perforated rotary basket of 600mm diameter fastened to a central vertical shaft which is connected to a 20hp vertical mounted electric motor with the aid of pulleys and belts. An outer solid basket of 730 mm diameter houses the perforated inner one thus maintaining a clearance of 65mm between each other (Plate 5).



Plate.4. 5: Centifuge

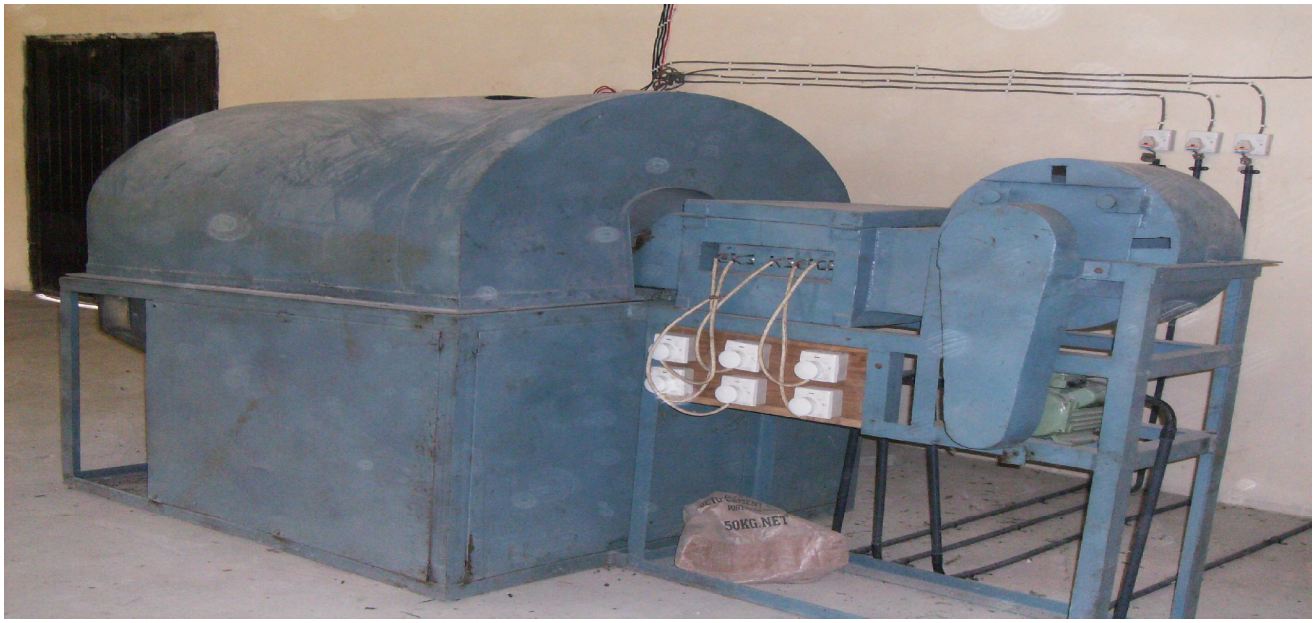
About 5 litres of sugar massercuit is put into the inner rotary basket. The material is well spread at the base of the basket with the aid of a long spatula or spoon. It is then put on to rotate at 1,350rpm for about 90-120 seconds. The sugar crystals which are trapped by fine screen in the inner basket are scooped out while the molasses that passes through the same fine screen are discharged into a trough. The machine can produce over 1,000kg of sugar crystal per day. The efficiency of centrifugation is over 99% (NCRI, 2008).

4.4.2.6 The Dryer

This machine was used to reduce the moisture content of the sugar crystal after centrifugation from about 25 to 5% (Plate 6). It is composed of a rotary basket having louvers that obtains power from a 15hp electric motor through a gearbox and pulleys

and belts. Inlet and discharge spouts for introducing wet sugar and releasing dried sugar are provided.

Electric heaters are provided to supply heat in the rotary drying chamber with the aid of a centrifugal fan. In order to minimize heat loss within the drying chamber, the rotary drum is insulated with fibre glass materials.



Palte 4. 6: The Rotary Dryer.

About 100kg of wet sugar crystal is introduced into the machine. The machine and the electric heaters are put on. The machine is left to rotate at 8rpm for about 30minutes before discharging the content. The capacity of the dryer is about 1000kg / day. The drying efficiency of the machine was over 98% (NCRI, 2008). Sugar granulation efficiency is over 95%. The general flow chart of brown sugar processing is shown in figure 1.

4.4.3 Other Miscellaneous Equipments:

4.4.3.1 Weighing Scale: The equipment was used in determing the weight of the sugarcane supplied by the farmer before processing and brown sugar after Processing. It is of 150-200kg capacity.

4.6.3.2 Bags and polythene Sealers: Two (2) hand refractor each of bags and polythene sealer was used in packaging the sugar into 0.5kg, 10kg and 50kg for distributing and handling.

4.4.3.3 Refractometer: Two (2) hand refractormeters of 45 – 90^0 brix range capacity are procured to determine the sugar content of sugarcane juice at the beginning and end of evaporation process.

4.4.3.4 Plastic Drums, Buckets and Trolleys: Three (3) each of the plastic drums, buckets and trolleys is provided. The plastic drums is being used for storage of mollasses while the buckets are being used in handling concentrated juice. Transportation of bagassee from the juice extractor to the drying fllor is done by the trolley.

4.4.4 Sugarcane : Sugarcane is sourced from farmers among whom the projects are sited. It was estimated that 25-30 farmers cropping 1.0 -2.0ha of land each produced at least 2000 tonnes of sugarcane at an average yield of 60 tonnes/ha. This supplies all the canes needed by each of the firms.

4.4.5 Okro-bark extract:

Okro stem bark extract which was one of the raw materials, can be planted

around the factory site on a 0.1 ha plot or intercropped with sugarcane .Okra stem extract is used in removing some organic solid materials during boiling of the sugar cane juice. Brown sugar is processed the natural way-completely free from any harmful chemicals such as phosporic acid, formic acid, sulfur dioxide, preservatives, or any flocculants , surfactants, bleaching agents or viscosity modifiers. Natural brown sugar has 11 calories / 4 gramms {1 teaspoon (tsp)} It is also nutritionally, rich and retains all natural mineral and vitamin content present inherent in sugarcne juice.

4.4.6 MANPOWER

The following categories of staff are employed:

4.4.6.1 Factory Manager: One factory manager who generally oversee day to day running of the factory as a permanent staff

4.4.6.2 Acoount/sales Clerk: An account /sale cerk took care of the sale and expenditure on dialy basis. He provided up-date account of the financial trnsactions. He is permanent staff

4.4.6.3 Skilled Artisan/ Machine Operators: Two skilled artisans were responsible for oparting the machines. They were skilled in repairs and maintenance of the machines/equipment handled by each of them.

4.4.6.4 Maseengers/security gaurds: Two security gaurds were fully engauged on permanent basis in addition to one maseenger.

4.4.6.5 Unskilled labour: Five labouerers were employed in each of the firms to assit the machine operators.

All the key staff had the basic requisite educational qualifications and

experience in their respective fields, however, they have been trained by a experience staff of NCRI, Badeggi before commissioning of the project.

4.4.7 Infrastructural Facilities:

4.4.7.1 Electricity supply through National Grid or power generating set (75-100KVA)

4.4.7.2 Borehole for water supply to the project

4.4.7.3 Good access road to the project

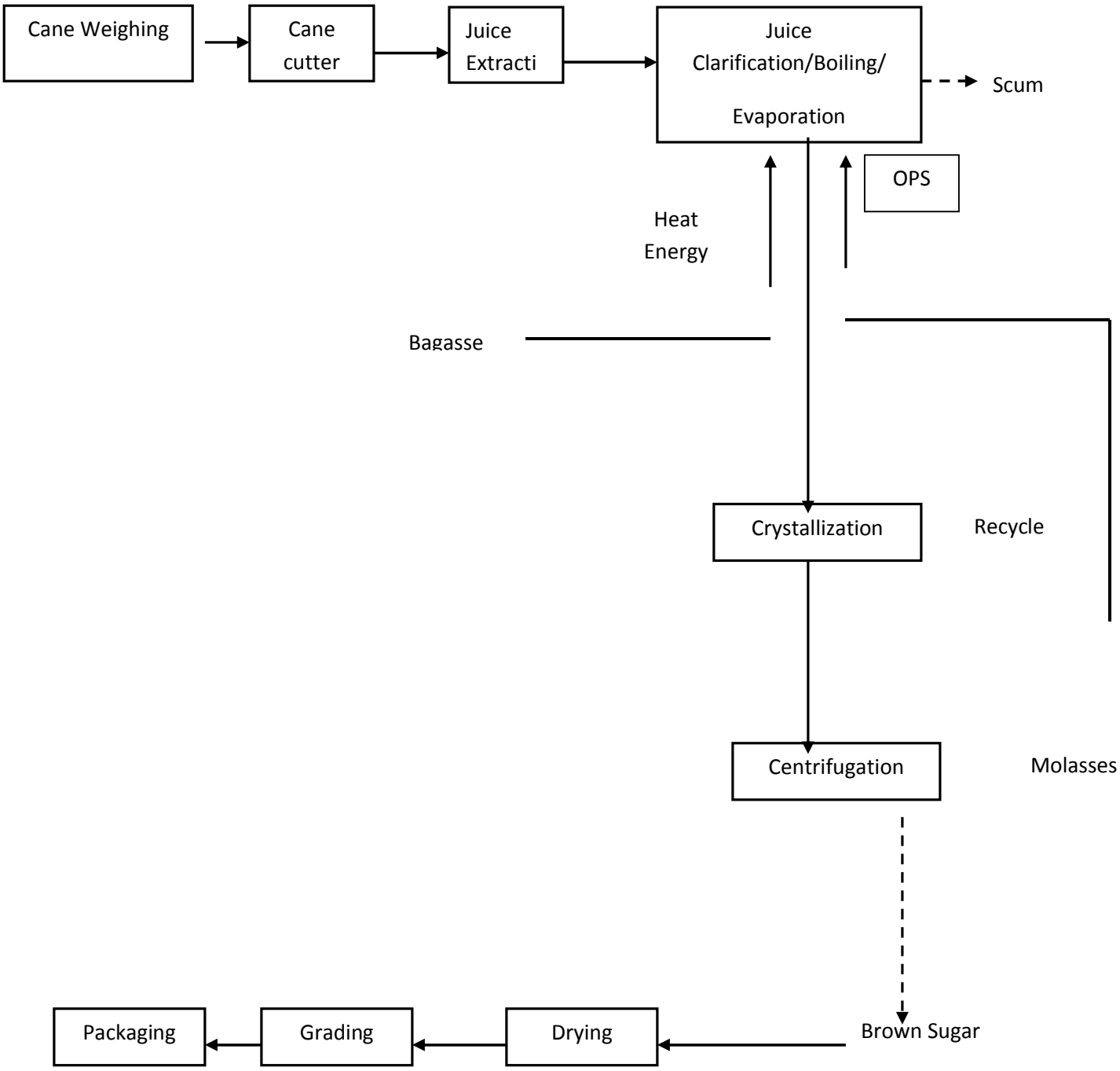


Fig. 1: Flow Chart of Brown Sugar Processing

4.5 Pay- Back-Period (PBP)

The Payback Period represents the amount of time that it takes for a capital budgeting project to recover its initial cost. Table 4.9 shows that the pay back period which is three years was common for all sites studied. However, as indicated earlier in chapter four, PBP have its disadvantages- i). **PBP** ignores any benefits that occur after the Payback Period. It does not measure total incomes, ii). **PBP** ignores the time value of money. Thus, it can not be used independently in determining the project viability/practicability.

Table 4.6: Pay - Back- Period (PBP) across the Sites /Pooled Data

S/No	Brown Sugar Mini – processing firms' locations	(a) Total Fixed Cost (₦)	(b) Total Variable Cost (₦)	(c) Total Investment Cost {(a) + (b)} (₦)	(d) Annual or yearly Revenue (₦)	(e) Annual or yearly Net Profit (₦)	(F) Pay-Back-Period (PBP) Years {(c) / (e)}
1	Omor-Anambra State	12,772,620	8,352,000	21, 124,620	22,692,000	10,974,738	1.92 + 1yr.of zero prod
2	Konar-Mada FCT-Abuja	12,127,200	6,490,000	18,617,200	19,552,000	10,233,680	1.82 + 1yr.of zero prod
3	Zaria, Kaduna State	12,142,200	6,490,000	18,632,200	22,140,000	13,001,680	1.43 + 1yr.of zero prod.
4	Sara, Jigawa State	12,163,200	6,490,000	18,653,200	23,324,000	14,005,680	1.32 + 1yr.of zero prod.
5	Gbajigi-Bida, Niger State	12,058,200	6,490,000	18,548,200	22,248,000	12,929,680	1.43 + 1yr.of zero prod.
6	Pooled Data	12,240,900	6,862,400	19,103,300	21,990,400	12,229,092	1.56 + 1yr.of zero prod.

Source: 2009/2010 Survey data, Financial Feasibility study on Five Brown Sugar Mini-Processing Firms in Nigeria

Note: - net profit in a normal year = Total revenue – { operation costs + interest charged (25%) + Depreciation}

- Straight line depreciation method is used for the fixed cost
- See Table 4.4 for fixed costs and variable costs
- See Table 4.5 for Sources of Annual or yearly Revenue
- 1 yr. of zero Prod…..____ 1 Year of zero production

4.6 BENEFIT – COST RATIO (BCR), NET PRESENT VALUE (NPV) AND INTERNAL RATE OF RETURN (IRR).

To provide information on the profitability or otherwise of brown sugar mini - processing firm and to answer objective 6 of the study, discounted cash flow analysis was carried out through which the Benefit-Cost Ratio (BCR), Net Present Value (NPV) and Internal Rate of return (IRR) were calculated.

4.6.1 Benefit – Cost Ratio (BCR).

The results of the analysis which is presented on tables 4.7 to 4. 12 shows that the Benefit – Cost Ratio (BCR) on the pooled data across the locations was 3.2. While for the firms sited at Omor of Anambara State, Konar-Mada of the FCT – Abuja, Zaria in Kaduna State, Sara in Jigawa State and Gbajigi – Bida of Niger State, the BCR obtained were 2.6, 3.0, 3.4 3.5, and 3.4 respectively. Given BCR at all locations greater than 1, indicates that the present value of the costs at the discount rate do not exceed the present value of benefits. Therefore, the enterprises at all locations studied have recovered their initials expenditure plus the return on investment from the projects. Thus, the project has shown a great sign for viability.

4.6.2 Net Present Value (NPV).

The results of the analysis presented on the same Tables 4.7 to 4. 12 also shows that the NPV across locations @ 25% = ₦54,005,492.58 and NPV @ 25% for sites at Omor of Anambara State, Konar-Mada of the FCT – Abuja,

Bazaire-Zaria of Kaduna State, Sara of Jigawa State and Gbajigi – Bida of Niger State were ₦50,842,558.5, ; ₦46,630,073; ₦55,868,982.02; ₦60.095,747.1 and ₦56,254,531.5; respectively. Given the positive NPV at all sites of processing, shows that brown sugar processing using the mini-processing plants were profitable at all locations studied. It implies that brown sugar mini - processing firms earned more than the discount rate, contributing positively to incremental national income.

4.6.2 Internal Rate of Return (IRR).

Found also on Tables 4.7 to 4.12 is the Internal Rate of Return results. The IRR for pooled data across location is positive and greater than 50%. For the sites located at; Omor of Anambara State, Konar-Mada of the FCT – Abuja, Bazaire-Zaria of Kaduna State, Sara of Jigawa State and Gbajigi – Bida of Niger State, the IRR were all positive and greater than 50%. The general principles is to consider a project worthwhile, if the IRR from the investments exceeds some suitable rates of investment such as Bank borrowing rates (25%) or the return earned in alternative investments. With IRR greater than 50% recorded across locations, it assured that the project was profitable/ worthwhile in the sense that the investment raised per-capital income relatively greater to what it otherwise would have been.

Table 4.7: Computation of NPV, IRR and BCR for Brown sugar Mini- Cottage processing firm in Nigeria - Using pooled data across the sites

PROJECT YEAR	GROSS COST N	GROSS REVENUE N	NET REVENUE N	DF @25%	NPV OF NET REVENUE @ 25% N	NPV OF GROSSS REVENUE @ 25% N	NPV OF GROSS COST @ 25% N	DF @ 50%	NPV OF NET REVENUE AT 50% N	IRR (25%)	IRR(50%)	BENEFIT-COST RATIO (BCR)@25% N
0	12,240,900	0	-12,240,900	0	0	0	0	0	0	124%	124%	3.20447657
1	6,862,400	21,990,400	15,128,000	0.80	12102400	17592320	5489920	0.667	10090376			
2	6,862,400	21,990,400	15,128,000	0.64	9681920	14073856	4391936	0.444	6716832			
3	6,862,400	21,990,400	15,128,000	0.512	7745536	11259084.8	3513548.8	0.296	4477888			
4	6,862,400	21,990,400	15,128,000	0.409	6187352	8994073.6	2806721.6	0.198	2995344			
5	6,862,400	21,990,400	15,128,000	0.32768	4957143.04	7205814.272	2248671.232	0.132	1996896			
6	6,862,400	21,990,400	15,128,000	0.262144	3965714.43	5764651.418	1798936.986	0.088	1331264			
7	6,862,400	21,990,400	15,128,000	0.209715	3172568.52	4611716.736	1439148.216	0.059	892552			
8	6,862,400	21,990,400	15,128,000	0.167772	2538054.82	3689373.389	1151318.573	0.039	589992			
9	6,862,400	21,990,400	15,128,000	0.134218	2030449.9	2951507.507	921057.6032	0.026	393328			
10	6,862,400	21,990,400	15,128,000	0.107374	1624353.87	2361197.21	736843.3376	0.017	257176			
Total	80,864,900	219,904,000	139,039,100		54005492.6	78503594.93	24498102.35		29741648	124%	124%	3.20447657

BCR = 3.2; NPV @ 25% = N54,005,492.58; IRR IS POSITIVE AND GREATER THAN 50%

NOTE: DF = Discount factor; NPV = Net Present Value; IRR = Internal Rate of Return and BCR = Benefit - Cost Ratio

Source: 2009/2010 Survey data, Financial Feasibility study on Five Brown Sugar Mini-Processing Firms in Nigeria

Table 4.8: Computation of NPV, IRR and BCR for Brown sugar Mini- Cottage processing firm sited at Omor, Anambra State

PROJECT YEAR	GROSS COST N	GROSS REVENUE N	NET REVENUE N	DF @25%	NPV OF NET REVENUE @ 25% N	NPV OF GROSSS REVENUE @ 25% N	NPV OF GROSS COST @ 25% N	DF @ 50%	NPV OF NET REVENUE AT 50% N	IRR (25%)	IRR(50%)	BENEFIT-COST RATIO (BCR)@25% N
0	12,772,200	0	-12,772,200	0	0	0	0	0	0	111%	111%	2.68544379
1	8,450,000	22,692,000	14,242,000	0.80	11393600	18153600	6760000	0.667	9499414			
2	8,450,000	22,692,000	14,242,000	0.64	9114880	14522880	5408000	0.444	6323448			
3	8,450,000	22,692,000	14,242,000	0.512	7291904	11618304	4326400	0.296	4215632			
4	8,450,000	22,692,000	14,242,000	0.409	5824978	9281028	3456050	0.198	2819916			
5	8,450,000	22,692,000	14,242,000	0.32768	4666818.56	7435714.56	2768896	0.132	1879944			
6	8,450,000	22,692,000	14,242,000	0.262144	3733454.85	5948571.648	2215116.8	0.088	1253296			
7	8,450,000	22,692,000	14,242,000	0.209715	2986761.03	4758852.78	1772091.75	0.059	840278			
8	8,450,000	22,692,000	14,242,000	0.167772	2389408.82	3807082.224	1417673.4	0.039	555438			
9	8,450,000	22,692,000	14,242,000	0.134218	1911532.76	3045674.856	1134142.1	0.026	370292			
10	8,450,000	22,692,000	14,242,000	0.107374	1529220.51	2436530.808	907310.3	0.017	242114			
Total	97,272,200	226,920,000	129,647,800		50842558.5	81008238.88	30165680.35		27999772	111%	111%	2.68544379

BCR = 2.68; NPV @ 25% = N50,842,558.5; IRR IS POSITIVE AND GREATER THAN 50%

NOTE: DF = Discount factor; NPV = Net Present Value; IRR = Internal Rate of Return and BCR = Benefit - cost Ratio

Source: 2009/2010 Survey data, Financial Feasibility study on Five Brown Sugar Mini-Processing Firms in Nigeria

Table 4.9: Computation of NPV, IRR and BCR for Brown sugar Mini- Cottage processing firm sited at Konar - Mada, Abuja - FCT

PROJECT YEAR	GROSS COST N	GROSS REVENUE N	NET REVENUE N	DF @25%	NPV OF NET REVENUE @ 25% N	NPV OF GROSSS REVENUE @ 25% N	NPV OF GROSS COST @ 25% N	DF @ 50%	NPV OF NET REVENUE AT 50% N	IRR (25%)	IRR(50%)	BENEFIT-COST RATIO (BCR)@25% N
0	12,127,200	0	-12,127,200	0	0	0	0	0	0	108%	108%	3.01263482
1	6,490,000	19,552,000	13,062,000	0.80	10449600	15641600	5192000	0.667	8712354			
2	6,490,000	19,552,000	13,062,000	0.64	8359680	12513280	4153600	0.444	5799528			
3	6,490,000	19,552,000	13,062,000	0.512	6687744	10010624	3322880	0.296	3866352			
4	6,490,000	19,552,000	13,062,000	0.409	5342358	7996768	2654410	0.198	2586276			
5	6,490,000	19,552,000	13,062,000	0.32768	4280156.16	6406799.36	2126643.2	0.132	1724184			
6	6,490,000	19,552,000	13,062,000	0.262144	3424124.93	5125439.488	1701314.56	0.088	1149456			
7	6,490,000	19,552,000	13,062,000	0.209715	2739297.33	4100347.68	1361050.35	0.059	770658			
8	6,490,000	19,552,000	13,062,000	0.167772	2191437.86	3280278.144	1088840.28	0.039	509418			
9	6,490,000	19,552,000	13,062,000	0.134218	1753155.52	2624230.336	871074.82	0.026	339612			
10	6,490,000	19,552,000	13,062,000	0.107374	1402519.19	2099376.448	696857.26	0.017	222054			
Total	77,027,200	195,520,000	118,492,800		46630073	69798743.46	23168670.47		25679892	108%	108%	3.01263482

BCR = 3.01; NPV @ 25% = N46,630,072.99; IRR IS POSITIVE AND GREATER THAN 50%

Source: 2009/2010 Survey data, Financial Feasibility study on Five Brown Sugar Mini-Processing Firms in Nigeria

Table 4.10: Computation of NPV, IRR and BCR for Brown sugar Mini- Cottage processing firm Sited at Zaria, Kaduna State

PROJECT YEAR	GROSS COST N	GROSS REVENUE N	NET REVENUE N	DF @25%	NPV OF NET REVENUE @ 25% N	NPV OF GROSSS REVENUE @ 25% N	NPV OF GROSS COST @ 25% N	DF @ 50%	NPV OF NET REVENUE AT 50% N	IRR (25%)	IRR(50%)	BENEFIT-COST RATIO (BCR)@25% N
0	12,142,200	0	-12,142,200	0	0	0	0	0	0	129%	129%	3.41140216
1	6,490,000	22,140,000	15,650,000	0.80	12520000	17712000	5192000	0.667	10438550			
2	6,490,000	22,140,000	15,650,000	0.64	10016000	14169600	4153600	0.444	6948600			
3	6,490,000	22,140,000	15,650,000	0.512	8012800	11335680	3322880	0.296	4632400			
4	6,490,000	22,140,000	15,650,000	0.409	6400850	9055260	2654410	0.198	3098700			
5	6,490,000	22,140,000	15,650,000	0.32768	5128192	7254835.2	2126643.2	0.132	2065800			
6	6,490,000	22,140,000	15,650,000	0.262144	4102553.6	5803868.16	1701314.56	0.088	1377200			
7	6,490,000	22,140,000	15,650,000	0.209715	3282039.75	4643090.1	1361050.35	0.059	923350			
8	6,490,000	22,140,000	15,650,000	0.167772	2625631.8	3714472.08	1088840.28	0.039	610350			
9	6,490,000	22,140,000	15,650,000	0.134218	2100511.7	2971586.52	871074.82	0.026	406900			
10	6,490,000	22,140,000	15,650,000	0.107374	1680403.1	2377260.36	696857.26	0.017	266050			
Total	77,042,200	221,400,000	144,357,800		55868982	79037652.42	23168670.47		30767900	129%	129%	3.41140216

BCR = 3.41.; NPV @ 25% = N55,868,981.95; IRR IS POSITIVE AND GREATER THAN 50%

NOTE: DF = Discount factor; NPV = Net Present Value; IRR = Internal Rate of Return and BCR = Benefit - Cost Ratio

Source: 2009/2010 Survey data, Financial Feasibility study on Five Brown Sugar Mini-Processing Firms in Nigeria

Table 4.11: Computation of NPV, IRR and BCR for Brown sugar Mini- Cottage processing firm sited at Sara, Jigawa State

PROJECT YEAR	GROSS COST N	GROSS REVENUE N	NET REVENUE N	DF @25%	NPV OF NET REVENUE @ 25% N	NPV OF GROSSS REVENUE @ 25% N	NPV OF GROSS COST @ 25% N	DF @ 50%	NPV OF NET REVENUE AT 50% N	IRR (25%)	IRR(50%)	BENEFIT-COST RATIO (BCR)@25% N
0	12,163,200	0	-12,163,200	0	0	0	0	0	0	138%	138%	3.59383667
1	6,490,000	23,324,000	16,834,000	0.80	13467200	18659200	5192000	0.667	11228278			
2	6,490,000	23,324,000	16,834,000	0.64	10773760	14927360	4153600	0.444	7474296			
3	6,490,000	23,324,000	16,834,000	0.512	8619008	11941888	3322880	0.296	4982864			
4	6,490,000	23,324,000	16,834,000	0.409	6885106	9539516	2654410	0.198	3333132			
5	6,490,000	23,324,000	16,834,000	0.32768	5516165.12	7642808.32	2126643.2	0.132	2222088			
6	6,490,000	23,324,000	16,834,000	0.262144	4412932.1	6114246.656	1701314.56	0.088	1481392			
7	6,490,000	23,324,000	16,834,000	0.209715	3530342.31	4891392.66	1361050.35	0.059	993206			
8	6,490,000	23,324,000	16,834,000	0.167772	2824273.85	3913114.128	1088840.28	0.039	656526			
9	6,490,000	23,324,000	16,834,000	0.134218	2259425.81	3130500.632	871074.82	0.026	437684			
10	6,490,000	23,324,000	16,834,000	0.107374	1807533.92	2504391.176	696857.26	0.017	286178			
Total	77,063,200	23,324,000	156,176,800		60095747.1	83264417.57	23168670.47		33095644	138%	138%	3.59383667

BCR = 3.59; NPV @ 25% = N60,095,747.1; IRR IS POSITIVE AND GREATER THAN

Source: 2009/2010 Survey data, Financial Feasibility study on Five Brown Sugar Mini-Processing Firms in Nigeria

Table 4.12: Computation of NPV, IRR and BCR for Brown sugar Mini- Cottage processing firm sited at Gbajigi-Bida, Niger State

PROJECT YEAR	GROSS COST N	GROSS REVENUE N	NET REVENUE N	DF @25%	NPV OF NET REVENUE @ 25% N	NPV OF GROSSS REVENUE @ 25% N	NPV OF GROSS COST @ 25% N	DF @ 50%	NPV OF NET REVENUE AT 50% N	IRR (25%)	IRR(50%)	BENEFIT-COST RATIO (BCR)@25% N
0	12,058,200	0	-12,058,200	0	0	0	0	0	0	131%	131%	3.42804314
1	6,490,000	22,248,000	15,758,000	0.80	12606400	17798400	5192000	0.667	10510586			
2	6,490,000	22,248,000	15,758,000	0.64	10085120	14238720	4153600	0.444	6996552			
3	6,490,000	22,248,000	15,758,000	0.512	8068096	11390976	3322880	0.296	4664368			
4	6,490,000	22,248,000	15,758,000	0.409	6445022	9099432	2654410	0.198	3120084			
5	6,490,000	22,248,000	15,758,000	0.32768	5163581.44	7290224.64	2126643.2	0.132	2080056			
6	6,490,000	22,248,000	15,758,000	0.262144	4130865.15	5832179.712	1701314.56	0.088	1386704			
7	6,490,000	22,248,000	15,758,000	0.209715	3304688.97	4665739.32	1361050.35	0.059	929722			
8	6,490,000	22,248,000	15,758,000	0.167772	2643751.18	3732591.456	1088840.28	0.039	614562			
9	6,490,000	22,248,000	15,758,000	0.134218	2115007.24	2986082.064	871074.82	0.026	409708			
10	6,490,000	22,248,000	15,758,000	0.107374	1691999.49	2388856.752	696857.26	0.017	267886			
Total	76,958,200	222,480,000	145,521,800		56254531.5	79423201.94	23168670.47		30980228	131%	131%	3.42804314

BCR = 3.42; NPV @ 25% = N56, 254,531.47; IRR IS POSITIVE AND GREATER THAN 50%

Source: 2009/2010 Survey data, Financial Feasibility study on Five Brown Sugar Mini-Processing Firms in Nigeria

4.7 SENSITIVITY ANALYSIS TEST

Tables 4.13 to 4.18, indicated that a 10% increase in cost of processing would lead to the BCR declined from 3.20; 2.6, 3.0, 3.4 3.5, and 3.4 to 2.91; 2.44; 2.73; 3.10; 3. 2 and 3.11 for the pooled data, Omor - Anambara State, Konar-Mada FCT Abuja, Baizare -Zaria kaduna State, Sara-Jigawa State and Gbajigi-Bida Niger State respectively. The NPV @ 25% also declined from ₦54,005,492.58; ₦50,842,558.5; ₦46,630,073; ₦55,868,982; ₦60,095,747 and ₦56,254,531 to ₦51,555,682.35; ₦47,825,990 ; ₦44,313,206;

₦ 53,552,115; ₦57,764,600.43; and ₦ 53,937,664 for the pooled data, Omor - Anambara State, Konar-Mada FCT Abuja, Zaria –kaduna state, Sara-Jigawa State and Gbajigi-Bida Niger State respectively. A small decline was also recorded in all sites but still maintained IRR greater than 50 %.

A 10% decline in prices of the outputs led to decline in BCR from 3.20; 2.6, 3.0, 3.4 3.5, and 3.4 to 2.88; 2.41; 2.71; 3.07; 2.61 and 2.60 for the pooled data, Omor - Anambara State, Konar-Mada FCT Abuja, Zaria kaduna State, Sara-Jigawa State and Gbajigi-Bida Niger State respectively. The NPV@ 25% also declined from from ₦54,005,492.58; ₦50,842,558.5; ₦46,630,073; ₦55,868,982; ₦60,095,747 and ₦56,254,531. to ₦38,304,774; ₦34,633,771 ; ₦ 32,670,324.3; ₦ 40,061,451.5, ₦ 43,442,863.6 and 40,369,891.1

for the pooled data, Omor - Anambara State, Konar-Mada FCT Abuja, Zaria kaduna State , Sara-Jigawa State and Gbajigi-Bida Niger State respectively. The IRR was also observed to have declined but still greater than 50% at all the processing sites studied (Tables 4.19 to 4.24).

Tables 4.25 to 4.30 shows that 20% increase in cost of processing would lead to the BCR declined from 3.20; 3.59; 3.49; 3.01; 3.42 and 3.41 to 2.23, 2.51, 2.84, 2.99 and 2.85 for the pooled data, Omor - Anambara State, Konar-Mada FCT Abuja, Zaria kaduna State, Sara-Jigawa State and Gbajigi-Bida Niger State respectively. The NPV @ 25% also declined from ₦54,005,492.58; ₦50,842,558.5; ₦46,630,073; ₦55,868,982; ₦60,095,747 and ₦56,254,531 to ₦44,800,855; ₦41,996,339 .94; ₦51,235,248; ₦55,447,733; ₦51,620,797; and ₦48455007.4, for the pooled data, Sara-Jigawa State, Omor - Anambara State, Konar-Mada FCT Abuja, Gbajigi-Biad Niger State and Zaria kaduna State respectively. A decline in IRR was also recorded in all sites but still maintained IRR greater than 50 %

20% Dcline in price of the outputs would lead to decline in BCR from 3.20; 3.59; 3.49; 3.01; 3.42 and 3.41 3 to 2.5, 2.14, 2.41, 2.72, 2.87 and 2.74 for the pooled data, Omor - Anambara State, Konar-Mada FCT Abuja, Zaria kaduna State, Sara-Jigawa State qnd Gbajigi-Bida Niger State respectively. The

NPV@ 25% also declined from ₦54,005,492.58; ₦50,842,558.5; ₦46,630,073; ₦55,868,982; ₦60,095,747 and ₦56,254,531 to ₦38,304,774; ₦34,633,771; ₦32,670,324.3; ₦40,061,451; ₦43,442, 863 and ₦40,369,891 for the pooled data, Omor - Anambara State, Konar-Mada Abuja-FCT, Zaria kaduna State and Gbajigi-Bida Niger State respectively. The IRR was also observed to have declined but still greater than 50% at all the processing sites studied (Tables 4.31 to 4.36).

4.7.1 Sensitivity Indicators and Switching Values on NPV and IRR

Table 4:37 shows that an increase in investment cost of 10%, will result in sensitivity indicator (SI) of 1.7, meaning that a change of (1.7 X 10%) = 17% in the expected NPV. The sensitivity Value (SV) is 58.8%, which is the reciprocal value of the SI X 100. This signified that a change of 58.8% in investment will cause the NPV to become zero. The table also demonstrated that a decline in revenue by 10%, will lead to SI of 1.4, thus, a change of 14% (1.4 X 10%) will occur in the expected NPV and the Switching Value (SV) of 71.42% for NPV to become zero. Similarly, an increase in investment cost by 20% will result in SI of 1.5 and SV of 66%. By 20% decline in revenue, the SI will be 1.85, and decline in revenue by 54% will cause the NPV to be zero.

The criteria is that, 'the higher the SI , the more sensitive is the NPV to the change in the variable concerened, and the lower the SV, the more sensitive is the NPV to the change in the variable concerned and the higher the risk with the project'. It is therefore, clear from Table 4.37 that SIs are below 2%, the SVs are more than 50% (higher) and the IRRs ranges between 87% to 124% . All these results pointed towards the financial feasibility of the project. No risk has been identified or indicated with the project.

Table 4.37: Sensitivity indicators and Switching Values on NPV and IRR

S/N0	Item	Change	NPV (N)	IRR (%)	SI (NPV)	SV (NPV)
1	Base case		54,005,492	124		
2	Investment	+ 10 %	51,555,682	107	1.7	58.8%
3	,,	+ 20%	49,105,872	94	1.5	71.42%
4	Benefit	-10%	46,155,133	106	1.4	66%
5	,,	-20%	38,304,773	87	1.85	54%

Note: SI – Sensitivity Indicator
SV-- Switching Values
Source: 2009/2010 Survey data, Financial Feasibility study on Five Brown Sugar Mini-Processing Firms in Nigeria

5.O SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

It has been found that over 250,000 hectares of sugarcane land is available in Nigeria (NCRI, 2002). There were seventy-five (75) Major sugarcane producing communities in the country (Table 4.1), and the average yield per hectare of sugarcane across the studied sites was 55 tonnes per hectare (Tables 4.2).

The simple rate of return of 10 tonnes crushing per day or of 1500 metric tonnes per year (five months crushing per year) of the mini-brown sugar cottage firms using pooled data across the studied sites was 64% (Table 4.5)

Brown sugar procesing inputs have been identified as: **-**

a. The Plant layout **-** Sugarcane Off-loading area, sugarcane milling area, bagasse drying Area, boiling area, finishing area, Packaging area ,store and two Main Offices.

b. The Machinery**-** Sugarcane Cutter, juice expeller, open pan evaporating system, crystallizer, centrifuge and dryer.

c. Other Miscellaneous Equipments : Wieghing scale, bags and polythene ,scalers, refractometer, plastic drums, buckets and trolleys

d. Sugarcane crop as the raw material

e. Okro-back extract as raw material

f. Manpower : Manager, account / sales clerk, skilled artisan / machine operators, messenger / security gaurds and unskilled labour.

i. Infrastructural Facilities: Borehole for water supply to the project, Electricity supply through national Grid or power geneating set (75-100 KVA) and

good access road to the project site,

Pay-Back Period (PBP) or the time that the project takes to return the averaged total value of fund (₦19,063,484) invested on it was three years (Table 4.6)

An average Benefit-Cost Ratio (BCR) of 3.2 was obtained at a suitable discount rate of 25%, which was quite greater than 1 and is acceptable from the normal selection criteria of independent projects (Table 4.7).

Net Present Value (NPV) which is an investment evaluation tool obtained by discounting the streams of net benefits using suitable interest rate @ 25%, was ₦54,005,492, from pooled data across the locations (Table 4.7).

Internal Rate of Return (IRR), which is the percentage interest rate at which the present value of the costs exactly equals the present value of the benefits or in other words, the discount rate that makes the net present worth of the incremental net benefit stream to be equal to zero was positive and even greater than 50% (Table 4.7).

Sensitivity analysis carried out using pooled data have shown that 10% and 20% either in increase in cost of processing or decline in prices of output (brown sugar and ₦ molases-liquid sugar) had no negative impact on the project (BCR= 2.91, 2.88 and 2.23, 2.5; NPV @ 25% = ₦51,555,682.35; ₦46,155,133 and ₦49,105,872; 38,304,774 IRR - positive (greater than 50%) and SIs 1.7, 1.4, 1.5 and 1.85 and SVs 58.8%, 71.4% , 66% and 54% (Tables 4.15 , 4.31 & 4.37).

5.2 CONCLUSION

This study undertaken to examine the financial feasibility of five brown sugar mini-processing firms in Nigeria have been able to established that there are

cultivable lands for sugarcane (as raw material for brown sugar Processing) production in the country and across the brown sugar mini-processing firms' sites studied. Every component of the financial analysis investigated in this study indicated that the project was feasible, profitable and viable. This project if finance even by Bank loan can be fully paid back in the third year of full operation. Therefore, the Null Hypothesis, that ' Brown Sugar Processing Mini-Processing Firm in Nigeria is not profitable' was rejected, while the alternative hypothesis that 'Brown Sugar Processing Mini-Processing Firm in Nigeria is Profitable' was accepted.

5.3 RECOMMENDATIONS

1. Land for Sugarcane culivation is available in the country. Farmers living in Rural areas where sugarcane are being cultivated should be educated on formation of sugarcane farmers' cooperative which will enable them to seek for loans from banks and invest into this profitable and viable venture

2. Nigerian government should encourage brown sugar processing using Mini-

Processing firms to help in bridging the gap (about 98%) between domestic sugar production and consumption in Nigeria and reducing the heavy amount of foreign exchange being spent annually on sugar importation. It will also be of assistance in providing rural employment and reducing rural-urban migration of youths therby assist in alleviating the poverty of the rural poor. . It will also play a part in the realization of the country's vission 20 : 2020

3. Local Government Area Chairmen in sugar cane producing States (NCRI, 2002), Abia, Adamawa, Anambara, Benue, Bayelsa, Ebonyi, Edo, Niger, Kaduna, Kogi, Kwara, ,Kebi, Katsina, Taraba, Osun, Jigawa, Ogun, Ondo, Plateau, Cross-River, River, Oyo,Kano, Imo Akwa-Ibom, and FCT-Abuja should be convinced to invest into this venture in their various localities. This will provide rural employment and reduce rural-urban migration of youths , thus assist in alleviating the poverty of the rural poor- a major programme of the present civilian administration. .

4. Private bodies or Non-Governmental Organization (NGOs) should be excited into brown sugar production, it is a profitab venture, even if bank loan is taken, it can be paid in a shorter period (three years) of full operation.

5. Research on brown sugar and Sugarcane Improvement should be properly financed by both governemnt and NGOs, so that high yielding varieties, that has high sucrose content, resistant to pest/diseases and also tolerant to draught be developed and be made available to farmers for massive sugarcane production to sustain the brown sugar factories

6. The fabricator of the brown sugar processing plant that used indeginous Knowledge in producing such machines should be recognized by both government and NGOs to go into more research on improvement of the machine conversion ratio (from sugarcane to brown sugar) so that

more sugar could be obatined from sugarcane than it is now (0.3Kg: 5kg).

7. Financial institutions such as micro-finance banks and Nigerian Agricultural cooperatives and Rural-Development Bank should be educated and given courage to grant credit facilities to both sugarcane farmers and prospective investors so as to enhance brown sugar production in Nigeria

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APPENDIX.I

A. QUESTIONNAIRE ON FINANCIAL FEASIBILITY AND VIABILITY STUDY OF BROWN SUGAR MINI- PROCESSING INDUSTRY IN NIGERIA

FARMERS' QUESTIONNAIRE

Dear Sugarcane farmer,

Information for this study is to enable the researcher carry out study on "Financial Feasibility and Viability of Brown Sugar Mini- Processing Industry in Nigeria" as pre-requisite for award of PhD Degree by Department of Agricultural Economics and Rural Sociology, Faculty of Agriculture, Ahmadu Bello University, Zaria. All information given remains confidential.

Geopolitical Zone……..State…….ADP Zone……..

LGA……Village……Date……..

Farmers' background Information

1. Sex of farmer male [ ], Female [ ]

2. Age of farmer, < 45 [ ] 46-60 [ ] > 60 [ ]

3. Highest Educational level obtained

[ ] Adult education, [] Koranic Education, [] primary, [] secondary,

[] Tertiary, [] Illiterate

4. Years of Experience in sugarcane farming (starting from when the farmer owned his own Sugarcane farm). [] <5, [] 6-15, [] 16-25, [] > 25

5. Major Occupation ……

6. Marital Status married [], Single []

Information on sugarcane production

7. Sir/Madam, do you grow sugarcane? Yes ( ), No ( )

8. If yes, what is the local or varietals name (s) of sugarcane you do grow

(i)……..…(ii)……..(3)……..

9. What is the size of your sugarcane farm (in hectares) under cultivation presently (2009) ?

(i). 0.25 -1ha; (ii) 1.1 – 2ha; (iii) 2.1 4 ha (iv) 4. 1 – 5 ha (v) > 5 ha

10. What was the yield/ha (tones/ha) recorded from your sugarcane farm last year (2008).?

…….Kg or ……bundles or ……tonnes.

11. Do you still have land that can be expanded for sugarcane production? Yes ( ), No ( )

12. If yes, estimate the land size still available ……...ha

13. What month of the year do you normally harvest your sugarcane?.....

14. Who are buyers of your produce (sugarcane)?-(i)----------(ii)

----------(iii)----------

15. What do they use the Sugarcane for?

(i).....(ii)……..(iii)……..(iv)……

……

16. How much do your sugarcane buyers pay per bundle ……...Per

tonne?.₦…….

17. How many sugarcane stalks makes up a bundle.……

18. Are you satisfied with the price being paid by your costumers per bundle /tonne?...

Yes ( ), No ( )

19. If no, how much do you think the buyers should pay per bundle / tonne? ₦ ……

20. How many sugarcane farmers do you have in this village?

21. Sir / madam could you roughly estimate land size that could be used for sugarcane

Production in this village?.....ha

22. Are you aware of the presence of brown sugar Mini-Cottage processing plant in your

town/Village? Yes ( ), No ( )

23. What are your comments on the presence of Brown Sugar Processing Machine in your

village/town?

i……..

ii……..

iii……..

24. What suggestion do you have for government in order to improve on sugarcane?

Production / brown sugar processing in your village and in the country at large?

1……

2……3……

……

……

4……

……

Thanks! May God bless you?

APPENDIX.II

B. QUESTIONNAIRE ON FINANCIAL FEASIBILITY AND VIABILITY STUDY OF BROWN SUGAR MINI- PROCESSING INDUSTRY IN NIGERIA

PROCESSORS' QUESTIONNAIRE

Dear Brown Sugar Processor

The information for this study is to enable the researcher carry out study on "Financial Feasibility and Viability of Brown Sugar Mini- Processing Industry in Nigeria" as pre-requisite for award of PhD Degree by Department of Agricultural Economics and Rural Sociology, Faculty of Agriculture, Ahmadu Bello University, Zaria. All information given remains confidential.

1. What is the name of your Brown Sugar Mini-Cottage processing firm (factory)?

   ……

   …….

2. When did you commission or established your brown sugar firm or factory?

   ..Day……..Month……..Year…….

3. How much does it cost you to establish this firm/factory / project? ₦ ……..

   Breakdown of the factory/firm / project cost

i Cost of land ₦……..

,ii. Cost of building ₦ ……

iii. Cost of External works ₦……..……

iv. Cost of Machinery and Equipments ₦…….

v Cost of Pick-up van ₦……..,……

vi. Cost of Stand-by Generator ₦……..

vii. Cost of digging a borehole for water supply ₦…….

vi. Cost of polythene bags ₦…….

vii. Cost of drums ₦……

viii. Cost of other packaging materials ₦……..

ix. Cost of installation, Commissioning and training ₦……..

4. What are the raw materials/ inputs you do use in brown sugar production ?

i)…….(ii)……

……...(iii)……

……

5. How many units/ kg /or tonnes of these raw materials / inputs can the plant crush in a day?

(i)……..(ii)……

…….(iii)……

……

6. How much does a unit / Kg / tonne of raw materials /inputs costs?

(i) Name of inputs (raw material) ……Cost per/nit Kg / tonne ₦…….-……

(ii) Name of inputs (raw material) ……Cost per /unit Kg / tonne ₦……..

(iii) Name of inputs (raw material) ……Cost per /unit Kg / tonne ₦…….

7. How many months do the firm/factory operates/work in a year?.....

8. How many people are employed in this firm/factory?.....

9. What are the categories of people employed?

   i)……

   ii)……

   iii)……..……

   iv)……

   v)……

   vi)……

   vii)……

   viii)……..

10. How many of these staff are permanent Staff?.....

11. How many of the staff are part time staff?.....

12. For how many months does the part time staff works?.....

13. What are the wages/salary paid to each category at the end of a month?.....

   i)……

   ii)……

   iii)……..……

   iv)……

   v)……

   vi)……

Vii)……

Viii)……

14. What are the final products of the firm / factory?

(i)……..……..

(ii)……..iii)……

……iv)……

……..……

15. What quantities of these products are being produced annually?

I)……...ii)……

……..iii)……

……iv)……

……

16. At what price do you sell these products to your customers?

i) ₦/Kg or ₦/50Kg bag ……...

.ii) ₦/Kg or ₦/50Kg bag…….

iii) ₦/Kg or ₦/50Kg bag……..……

iv). ₦/Kg or ₦/50Kg bag…….

16. What are your comments on the general performance of the firm/factory?

……..……

……

17. Comments on the buyers (costumers) behaviours……..

…….

……

18. What suggestion do you have in other to improve on brown sugar production in Nigeria?

i)…….

……..

ii)……..

…….

Thanks! May God bless you?