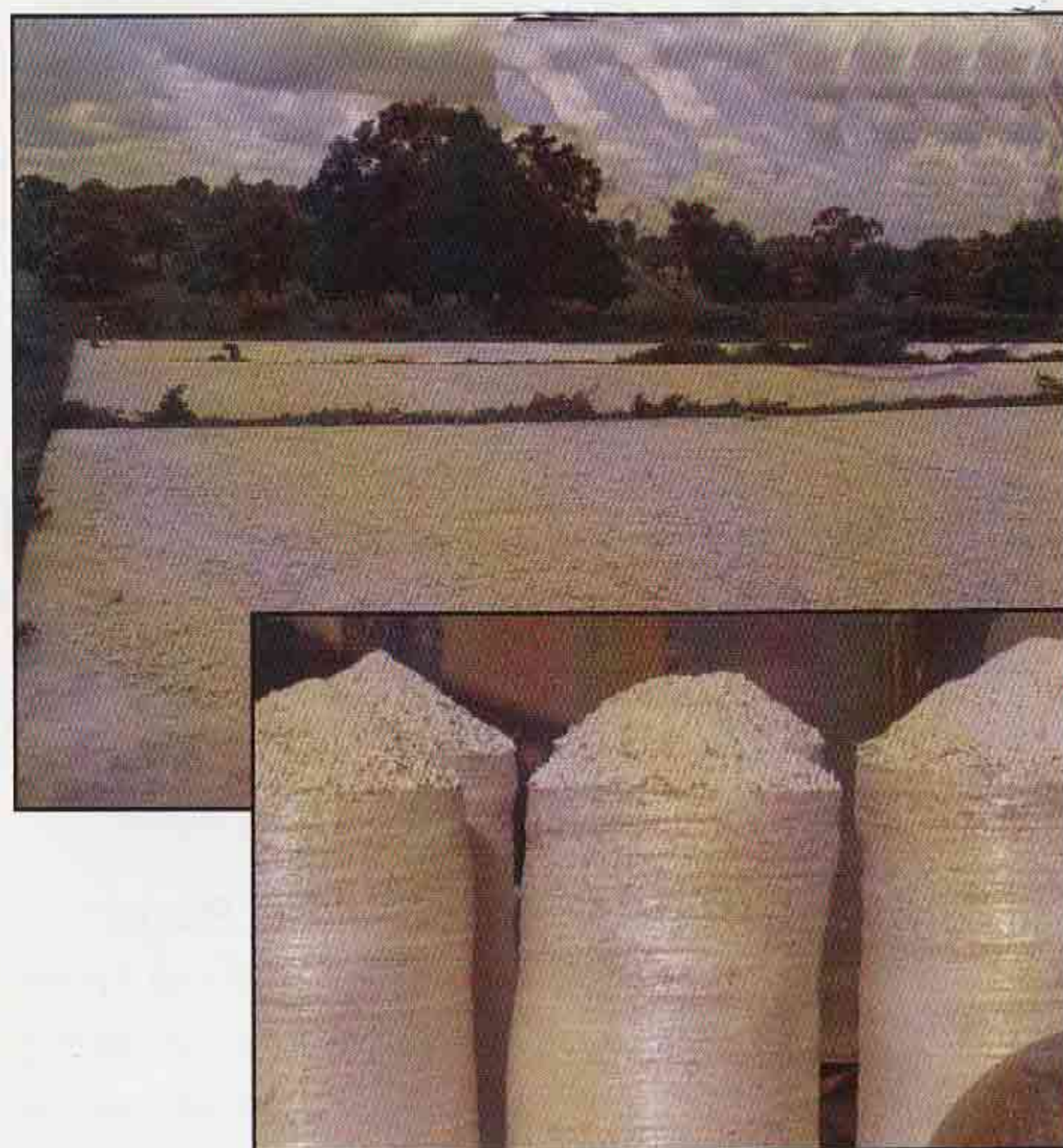


additional 15% at the profits side. This is a harsh investment climate possible to find in many Nigerian States. Under the stringent tax regime, the internal rate of return (IRR) of the plant is positive at 30%. This suggests a viable investment. The second scenario relaxes the 15% taxes at the profits side, yet the investment shows a positive internal rate of return of 37%.

The most viable venture can be obtained from a five-year partial tax holiday environment, relaxing the 10% tax at the cost side. This gives a 96% IRR on the investment of a the 6500LPD ethanol plant. Other critical issues to watch in the cash flow analysis are the consistent supply of raw material at a price below N18000 per ton of cassava flour from chips. On the other hand, with an increase of 15% in the raw material price, the only profitable venture is that with a five-year

Exchange rate: US\$ 1=N130



partial tax holiday environment, relaxing the 10% tax at the cost side. This alternative will determine 59% of internal rate of return.

Information on prices across Nigeria of cassava roots, chips, and flour are published weekly in www.cassavabiz.org.

Factory gate prices for ethanol, starch, flour and adhesives are also published on this website.

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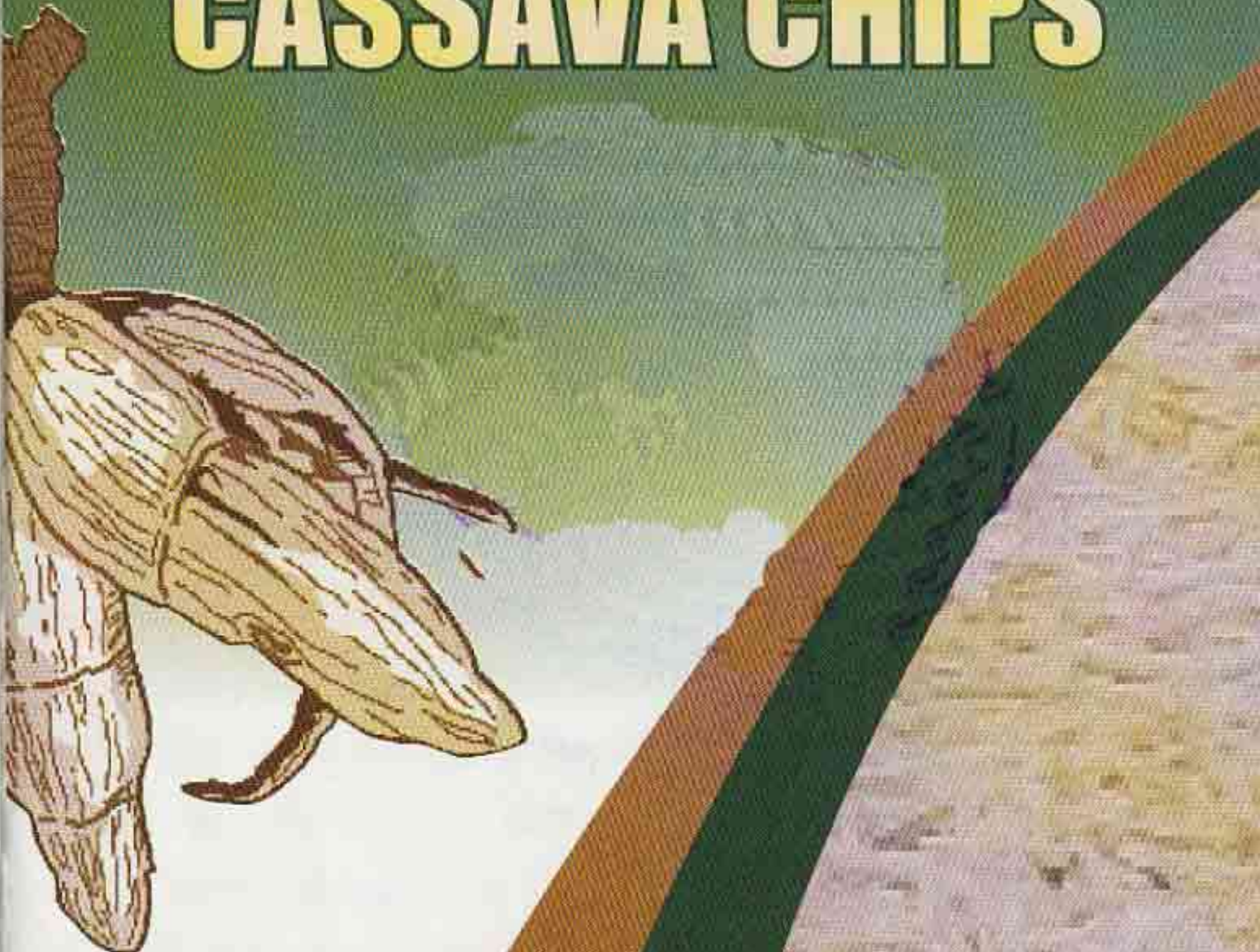
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Investment and Profitability in Cassava Enterprises

ETHANOL FROM CASSAVA CHIPS





The purpose of this brochure is to show the technical and financial requirements that are required for the installation of small distilleries to produce ethanol using cassava chips. The analysis includes different technical capacities and financial scenarios to guide investments in the establishment of this cassava enterprise in Nigeria.

Ethanol can be produced from sugar or high starchy crops such as roots and tubers and from biomass. Biomass is the organic wastes from forest wood, switch grass, corn stovers, rice hulls, bagasse, pulp and paper residue, sawmill residue, etc. Biomass can be used in three sectors (i.e. electricity, heat, and ethanol). There are three major technologies for converting biomass to fuel: thermal processes, biological processes (i.e. acid and enzymes hydrolyses) and extraction processes.

Trends in ethanol production and the Nigerian market

There are primarily three grades of ethanol namely, (a) Industrial grade, (b) Beverage grade and (c) Fuel grade. The Kyoto Protocol and Convention on Climate Change Protection has placed increasing pressure on world ethanol production. Global ethanol output is currently put at 10.2 billion gallons (40 billion liters) per annum. Fuel ethanol demand will increase ethanol production to nearly 70 billion liters per annum by 2012 at 5-10% annual growth rate. Globally, over 60 % of ethanol comes from sugar and Brazil provides over 50 % of world supply.

The Nigerian domestic market for ethanol is currently estimated to be 180m liters per annum. Ethanol in Nigeria is used primarily for industrial and beverage purposes.

Enterprise analysis for a small scale ethanol plant

The cassava required (1.2 million tons) for producing the annual ethanol requirement (180million litres) in Nigeria can be conveniently sourced within the country. The greatest

challenge to cassava production is how to reduce field production costs. The best way to do this is to complement disease resistant, high yield IITA varieties with full or partial mechanized production techniques, good agronomic practices and use of purchased input.



The total land area required to satisfy 6500LPD ethanol plant for 300 working days in a year is approximately 750ha if yields remain at 20t per hectare. Twice this area of land will be needed for sustained and consistent supply over a five-year period.

The carbon dioxide produced during the fermentation can be purified and sold to the soft drink companies and breweries in Nigeria; CO₂ could also be sold as fire extinguisher, realizing reasonable money from this by-product. A kilogram of CO₂ in Nigeria sells for ₦168 (\$1.2). The DDG can also be sold as

livestock feeds. The stillage or backset at the distillation can similarly be sold as protein source for the cattle and could be recycled as long as infection can be avoided; for reuse in the production processes which will save some costs on water, nutrient and energy. This will obviously bring down the total cost per liter of ethanol, thereby improving the profit margin of the ethanol plant. The market price of extra neutral alcohol (96%v/v) is put at ₦82 per liter but the current (2005) market price ranges between ₦85 and ₦90 per liter.

The actual economics for the producer of ethanol depend upon the cost of production and the comparison of this with the value in sales of the ethanol produced. The critical factor here is the actual ethanol yield. Considering all relevant assumptions, a ton of cassava starch with 75% (min) of starch should give about a yield of 440litres per ton but a consistent yield of 395-436litres per ton is possible (Bamikole 2002).

Small scale (1.95 million LPY) ethanol plant in Nigeria offers economies of scale as well as economic efficiencies resulting from efficient production and marketing of ethanol and byproducts (DDGS and CO₂).

Net income of ₦72,660,419 can be obtained from a small cassava ethanol plant of 6500LPD. The total cost of the investment is ₦19, 389,000. The variable costs account for 83 percent of the total cost while the investment cost accounts for 13 percent. Fixed cost comprising of administrative and personnel costs and interest on capital calculated at 22.5% of the current bank rate account for four percent of the total cost of the investment.

Cash Flow Analysis for 6500LPD Ethanol Plant

The estimated cash flow analysis for a 6500LPD ethanol plant can be analyzed in three scenarios ranging from a very strong tax regime to a five-year partial tax holiday. The first scenario presents a stringent tax regime of 10% at the cost side and