



## Business Plan Document

M/S. VARI AGRO COMPANY LTD,  
TANZANIA

POTABLE ALCOHOL (HIGH GRADE ENA) & FUEL ETHANOL PROJECT

PROJECT SITE

Songea District, Ruvuma Region, Tanzania

## CHAPTER 1 EXECUTIVE SUMMARY

### PROJECT AT A GLANCE:

VARI AGRO COMPANY LTD, TANZANIA wants to establish plant to produce 100 KLPD grain-based Potable-grade Ethyl Alcohol (Extra Neutral Alcohol 96.2%) and 30KLPD 99.9% Fuel grade Ethanol along with 4 MW capacity Cogeneration Power Plant for meeting the power demand of the alcohol and Ethanol production complex. The commercial & social infrastructure around the proposed site is considered quite well for setting up the proposed project.

The integrated project comprises of a factory for the manufacture of high-grade Potable Alcohol and Fuel Grade Ethanol from grain, mainly Maize. The command area of the proposed project has excellent cultivation and potential for sustained grain supply for operating the Alcohol plant for 330 days of operation.

The aggregated capital investment for the integrated project has been estimated at **around US\$ 25M to 35M**

### PROJECT RATIONALE

The promoters have extensively and carefully analysed the present and future scenario of Potable Grade Alcohol and Fuel Grade Ethanol & other types of Alcohol industries globally. They have studied carefully the present & future availability of raw materials in the surrounding area for expansion in future.

VARIA GRO COMPANY LTD, TANZANIA has acknowledged in depth, the socio-economic and environmental value addition of this integrated project to the local populace, region and the country, as well as its win-win situation to all the stakeholders involved.

## THE PROMOTERS & PROJECT PREPAREDNESS:

M/s. VARI AGRO COMPANY LTD - group Company of OSWAL GROUP GLOBAL, is prepared to invest 100% capital including working capital for setting up POTABLE GRADE ALCOHOL and FUEL GRADE ETHANOL plant in TANZANIA.

Company has a team of very dynamic and progressive professionals at the Board level. The management under the dynamic leadership of Mr. Pankaj Oswal, the Chairman and Managing Director of VARI AGRO COMPANY LTD.

## BOARD OF DIRECTORS:

1. Mr. Pankaj Oswal, CMD
2. Mrs. Radhika Pankaj Oswal, Executive Director
3. Ms. Vasundhara Oswal, Director Finance
4. Ms. Riddhi Oswal, Director

## BACKGROUND OF VARI AGRO COMPANY LTD:

Oswal Group Global evolved out of Oswal Group India was formally established in India in the year 1912. Oswal Group Global is now a worldwide multibillion dollars enterprise and has several business units which comprises Bauxite mining in Guinea, chemicals in India, Project Management in India, Real Estate In Switzerland and Europe.

VARI AGRO COMPANY LTD., an Oswal Group Global holding company, has decided to set up a 100,000 litres per day state-of-the-art Potable Alcohol plant and 30KLPD Fuel Ethanol Plant in TANZANIA (proposed site: at **Songea District, Ruvuma Region, Tanzania**) using grains (mainly corn & alternately Sorghum) as feed stock. The Alcohol products are proposed to be sold in African Markets. This plant encompasses an unique technology for 100% recycle of waste i.e **Zero Liquid Discharge**.

### Mission Statement:

To create opportunities for the agricultural sector/farmers by processing their resources into more valuable products by employing latest environment friendly technologies & create sustainable eco-system beneficial to all stakeholders.

### Vision Statement :

To be one of the world's leading producers of High quality Ethanol Products to be utilized in multitude of Industries by engaging local skills with most compliant environment friendly practices & technologies.

## CHAPTER 2

### PROJECT SYNOPSIS OF POTABLE GRADE ALCOHOL PRODUCTION

Project Name	:	Potable Alcohol and Fuel Ethanol Project
Name & Address of organization	:	<b>VARI AGRO COMPANY LTD</b> Lns consulting, 1 OYSTERBAY STREET, 344 GHUBA ROAD, KIMBIJI HOUSE, FIRST FLOOR. Postal code 14111 Dar es salaam ,Tanzania
Type of Organization	:	Private Limited Company
Project Site	:	Songea District, Ruvuma Region, Tanzania
Working Days	:	330 per year
Products & Byproducts	:	<ol style="list-style-type: none"><li>1. POTABLE GRADE ALCOHOL - 100,000 Ltrs/Day (or 30,000 Ltr/day in case Fuel Ethanol is produced same day). Sale to Drinkable Alcohol companies or Pharma/food industries as intermediate products</li><li>2. Distilled Dried Grain Solubles (DDGS) - - 80 MT/day Sale to Food for Animal, Poultry &amp; Aquaculture etc</li><li>3. Impure Alcohol (5,000 Ltrs /day) - FOR sale to Perfumery, Paint &amp; other industries as solvent.</li><li>4. Fuel Ethanol : 30,000 Ltr/day (Provisional Capacity) Blending with Petrol as fuel</li><li>5. CO2 : 50 MT /day For sale to soft drinks / beverage making, refrigerant industries, food packaging</li><li>4. Fly Ash - for Brick making, Cement Industries</li></ol>
Raw Material	:	250-300 Tons per day Corn Appx 99,000 Tons per annum
Power Consumption per hour	:	4.3 MW (Produced at site using Turbine run by High Pressure Boiler Steam)

No electricity is required from grid.

For emergency power backup 0.7 MW DG sets are considered.

Boiler Plant Capacity	:	40 Ton per hour at 45 Bar (G) Pressure
Fuel for Boiler	:	Coal : 175 Tons per day 58000 Tons per annum Alternately Biomass Such as Bagasse, corn cobs, wood chips, etc.
Air Emission control for Boiler	:	with Electrostatic Precipitator & Chimney
Water Requirement per day effluent	:	1.5 Million Ltrs after 100% recycle of treated  (From Borewells at Plant site & from nearby river sources)
Implementation Schedule	:	20-24 months

## PROJECT BRIEF

**Potable Grade Alcohol** plant having capacity of 100 KLPD will be installed along with Cogen Power plant as a part of the integrated project. Plant will operate for 330 days per year. The requirement of Potable Alcohol from year 2021 to 2025 is expected to grow at 7-8%. African Countries & South East Asia looks to be niche market for supplying Potable Grade Alcohol. In addition the plant will also have facilities to produce 30 KLPD Fuel Ethanol.

The proposed grain-based Ethanol plant will use state of the art technology to ensure optimum output & lowest energy as well as less input raw material & water consumptions. Raw material for the plant is ensured with a continuous supply & considered as corn (alternately Cassava) available nearby. The process plant will include Grain Cleaning, Milling, Liquefaction, Fermentation, Multi-pressure Distillation process to produce POTABLE GRADE ALCOHOL. In addition the plant will have Dehydration section for producing FUEL ETHANOL. The plant is encompassing a state of art technology to process stillage into valuable product DDGS (Distiller's dried grains with solubles), which is considered to be the latest in the Alcohol industry in Tanzania. Evaporation technology will be used to reduce the effluent generation and convert the same in to DDGS product. The CO<sub>2</sub> gas generated during fermentation process shall be recovered and bottled in cylinders as valuable product for beverage industry. The configuration of liquid waste treatment planned for the project has no discharge of wastewater at all from the plant.

### ENVIRONMENT IMPACT:

Proposed project is a **ZERO LIQUID DISCHARGE PLANT** and shall create no pollution to the environment. The process has been specifically developed to treat effluent from a alcohol plant i.e. spent wash comprising of steps such as decantation, evaporation and subsequent drying in the steam tube bundle dryer to produce protein rich 'DDGS' used as food for Cattles, Poultry & Aquaculture. The condensate water is treated in a most advanced technology mainly consisting of air/steam strippers followed by combination of Ultrafiltration - Reverse Osmosis Membranes, Ozonation & Ultraviolet system. The Process condensate thus treated shall be completely recycled back into the process & utilities. It is a must to ensure that the quality of treated condensate is as good as fresh water else the overall process would be disturbed. Other waste waters from Boiler, Cooling tower, Floor washing & water treatment plant rejects are treated in 'Rejects Recycling Plant' & shall be used for Ash quenching. The ash generated by burning Coal in Boiler shall be used for Brick making

in future. The Boiler is provided with necessary equipment's such as electrostatic precipitator to arrest particulate matter emission in air. The CO<sub>2</sub> generated in fermenter is being recovered & sold as product to beverage industries while provision has been kept for unused CO<sub>2</sub> to be scrubbed so as to avoid any odour nuisance. The overall plant has been designed to ensure compliance to world-class environment norms for all sorts of Pollution parameters. The details of the ZLD are enumerated in this document in relevant sections.

## STRENGTHS OF THE PROJECT:

The main strengths of this integrated project include:

- Background and experience of the promoters in the business
- Experienced, willing and committed promoters
- Demand supply gap in POTABLE GRADE ALCOHOL, FUEL ETHANOL, DDGS & CO<sub>2</sub> in African Countries
- Conducive policy / regulatory framework of TANZANIA Government.
- Sustained availability of raw materials includes Corn & Cassava
- Sustained availability of boiler fuel such as Coal & alternately Bagasse
- Substantial socio-economic and environmental benefits
- Latest technology equipments with highest efficiency
- Sound techno commercial viability
- Totally Zero Liquid Effluent Discharge & 100% environment compliant process technology

## RISKS & MITIGATION

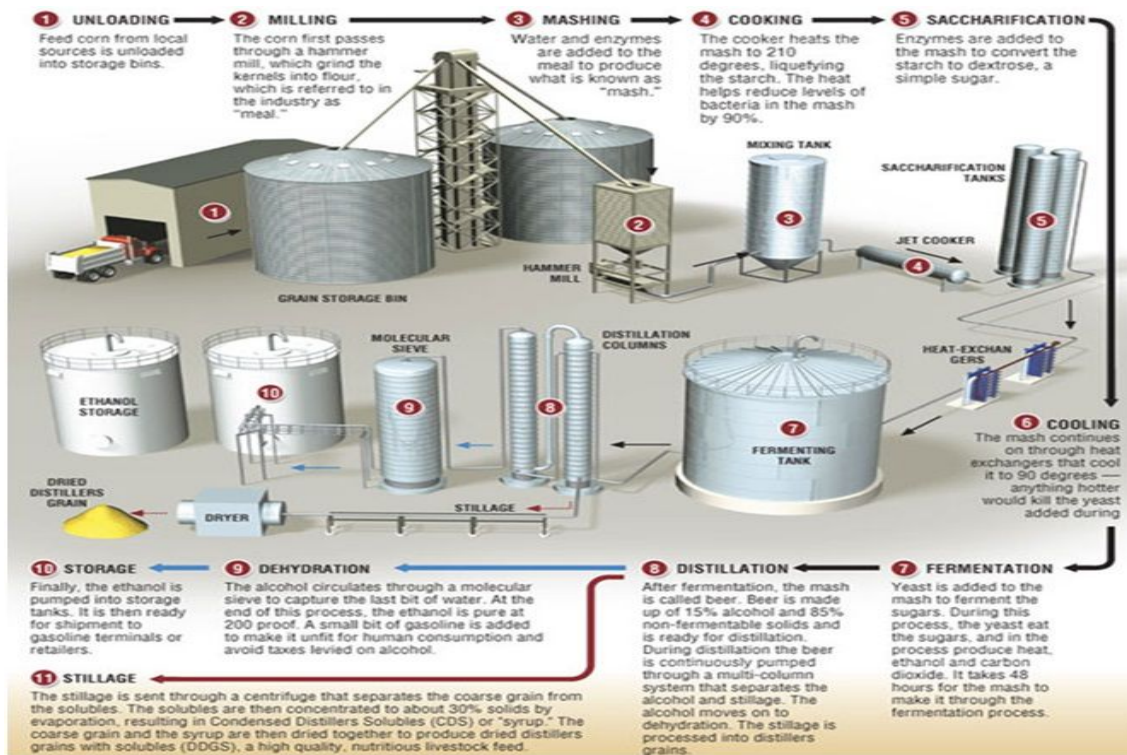
Risk	Particular	Mitigation
Performance risk	Raw material availability	TANZANIA annually produces around 7 Million MT of Corn per year. M/S. VARI AGRO COMPANY LTD. Shall require about 90,000 tons per year of Corn. For which PIL shall tie up with various farmers, agents for continuous supply of Corn and alternately Cassava
Marketing risk	Potable Alcohol(ENA)	Firm marketing ties up in offering for local & export to Free Zone countries. Alternative marketing channels for other countries in Africa & Middle East are explored. Value added products proposed.
Regulatory risk	Conversion / clearances	Being 100% Foreign Direct Investment, no difficulty/complexity envisaged. TANZANIA governmental agencies have already expressed their willingness to issue approvals / consents. All the approvals in the initial stages.
Financial risk	Financial viability of the project	The payback is expected to be 4 years 11 months.

## Proposed technology for manufacture of Alcohol from Cereal Grains

The chemical process and manufacturing technology for grain based Potable Grade Alcohol(ENA) is critical since starch is present in the grains & it cannot be directly used for fermentation by the yeast. It is necessary to grind and process the grains prior to fermentation involving following additional processes and for these additional plant and machinery is required. The additional processes are:

- Slurry preparation of Starch
- Liquefaction of Starch (Conversion of starch into dextrin) by enzyme alpha-amylase
- Conversion of liquefied starch into glucose by Amylo-Glucosidaze
- Fermentation of Glucose with Yeast
- Distillation of Fermented wash to produce 96.2% alcohol (Potable Grade Alcohol)
- Part production of Fuel Ethanol (99.5% Alcohol) by Dehydration columns
- Treatment of Spent wash/effluent to convert into DDGS (Protein Rich Animal Feed)
- CO<sub>2</sub> gas recovery & compressing to liquid form (Beverage grade)
- Zero Liquid Discharge by treating all effluents to recyclable quality inside plant

The Technology encompasses a simultaneous process of Saccharification & Fermentation which saves material & has higher efficiency of producing Alcohol with minimum resources. For concentrating & purifying Alcohol, very latest Multi-Pressure Distillation process is selected which is a combination of vacuum & pressure to enable energy conservation & non-stop operations. The production process has been developed in USA. The chemical reactions in the process and required intervention in the technology has been described in detail in the report.



## Uses of Potable Alcohol:

The main demands for POTABLE GRADE ALCOHOL are as follows:

1. For making Drinkable grade alcohol blends
2. For high grade pharmaceutical products
3. For cosmetics products
4. Perfumery

## Uses of Fuel Ethanol:

1. For blending with Petrol as motor vehicle fuel

## Sustainability and Financial Viability of Grain-Based Technology:

The technology is practicable & in use in existing grain-based alcohol plants worldwide. Required plant and machinery will be sourced from India where most of the reputed suppliers have established large number of alcohol plants worldwide in their life-time and have contributed to evolving techno-economically sound & environment friendly process technologies. The supplier for design, manufacturing, supply and installation considered:

## **TECHNOLOGY PROVIDER:**

**KBK Chem Engg Pvt Ltd, India:** This is a world renowned Wilmar Group Company operative since 1997. KBK has executed over 60 projects globally and is a popular name in the field of Alcohol plants in many countries abroad including India, Brazil, Philippines, Ethiopia, Vietnam, Tanzania, Thailand, and TANZANIA. KBK has a unique distinction of working with various feed stocks for the Alcohol plant like molasses, sugarcane juice, sugar beet juice, grains (Corn, rice, spent grains) and sweet sorghum juice. Wilmar group has their own many Alcohol Production plants and hence it would be added advantage to PIL wherein KBK's knowledge is based on hands-on-experience on their Alcohol Production activities.

## **EVERGROWING MARKET DEMAND:**

There is a substantial quantum of research documents available in the market corroborating facts that the demand of food/potable grade alcohol is ever-growing with the diversion of alcohol products to fuel ethanol as well as growth in other applications. we showcase a demand supply table for about 10 years from one of such available research report:

### **Global Extra Neutral Alcohol (ENA) Production and Growth Rate Segment by Product Type from 2015-2027F (Million Liters)**

	2015	2016	2017	2018	2019	2020
Industrial grade	6532.21	6858.05	7228.23	7688.75	8175.16	7559.34
Pharma grade	4952.36	5177.71	5438.73	5773.91	6149.98	6362.32
Food grade	33011.04	34610.31	36485.62	38742.69	41080.07	36373.35
Total	44495.61	46646.07	49152.59	52205.36	55405.22	50295.00

	2020	2021F	2022F	2023F	2024F	2025F	2026F	2027F
Industrial grade	7559.34	8105.98	8602.92	9050.78	9574.86	10045.00	10560.31	11141.15
Pharma grade	6362.32	6101.04	6459.33	6822.71	7232.07	7618.96	8001.09	8428.13
Food grade	36373.35	39689.11	42099.98	44344.63	46855.67	49169.04	51746.92	54556.78
Total	50295.00	53896.13	57162.23	60218.12	63662.60	66833.00	70308.31	74126.05

Source: Maia Research Analysis

## ENVIRONMENTAL MANAGEMENT PLAN:-

Following mitigation measures shall be adopted to minimize the impact of project on the surrounding environment:

Environmental Attributes	Mitigation Measures
Air Quality Management	Process Emission

- Bag filters shall be provided for PM emissions.
- CO<sub>2</sub> gas produced during fermentation shall be recovered & liquified in CO<sub>2</sub> Recovery plant & additionally scrubber shall be provided to scrub CO<sub>2</sub> emissions in water in case of CO<sub>2</sub> plant not running.
- The whole process will be carried out in closed condition so as to avoid any chances of VOC emissions.

### Utility Emission

- All the diesel generator sets shall be standby arrangement and will only be used during power failure.
- Adequate stack height shall be provided to Boiler and diesel generator sets.
- Electrostatic Precipitator shall be provided as an air pollution control device to the boiler with approximately 99% efficiency to capture maximum boiler fly ash.

### Fugitive Emission

- The main raw material and product shall be brought in and dispatched by road in covered enclosures.
- Raw CO<sub>2</sub> is transferred through a closed pipeline to proposed CO<sub>2</sub> recovery plant and Liquid CO<sub>2</sub> product shall be stored in cylinders & tanks. Product shall be dispatched by road in covered enclosures & closed tanks
- Bag filters/ Dust collectors shall be installed at loading-unloading section to minimize the PM emission at the site.
- Dust suppression on haul roads shall be done at regular intervals.

## Water & Wastewater Management

- The proposed Grain based Alcohol/ethanol plant will be based on “Zero Liquid Discharge technology.
- Spent wash or the main effluent from the Alcohol/ethanol plant shall be treated through Centrifuge Decanters followed by Evaporators and dryer and the waste shall be converted into DDGS product which shall be used as cattle feed / fish feed as it contains higher protein and fibre content.
- The condensate from evaporators & spent lees from distillation section shall be treated to remove all impurities in Condensate Treatment Unit consists of Air Stripper/Steam stripper, Ultrafiltration & Reverse osmosis membrane systems, UV, Ozonation & Activated Carbon filter. After treatment the clean condensate is completely recycled for process plant & cooling tower without any discharge outside the plant. The other reject waste streams such as boiler blow down, cooling tower blow down, Floor Washing,

Laboratory wastewater & Water Treatment Plant Rejects etc shall be treated in Reject Concentration Plant consisting of pH correction, Ultrafiltration & Reverse osmosis membrane units. The concentrate shall be used for Quenching of Ash generated in Boiler after burning coal as fuel & clean permeate shall be used in Boiler feed water stream & process plant as applicable.

- The domestic wastewater from Toilets & Urinals shall be treated properly & used for gardening & green belt watering.
- Proper storm water drainage will be provided during rainy season to avoid mixing of storm water with effluent.
- Rain water harvesting from the catchment area will be done for the proposed ethanol plant project.

## Noise Management

- Closed room shall be provided for all the utilities so as to attenuate the noise pollution.
- Acoustic enclosure shall be provided to diesel generator sets.
- Free flow of traffic movement shall be maintained. Earmuffs shall be used while running equipment's of the plant.
- Proper maintenance, oiling and greasing of machines at regular intervals shall be done to reduce generation of noise.
- Greenbelt shall be developed around the periphery of the plant to reduce noise levels.

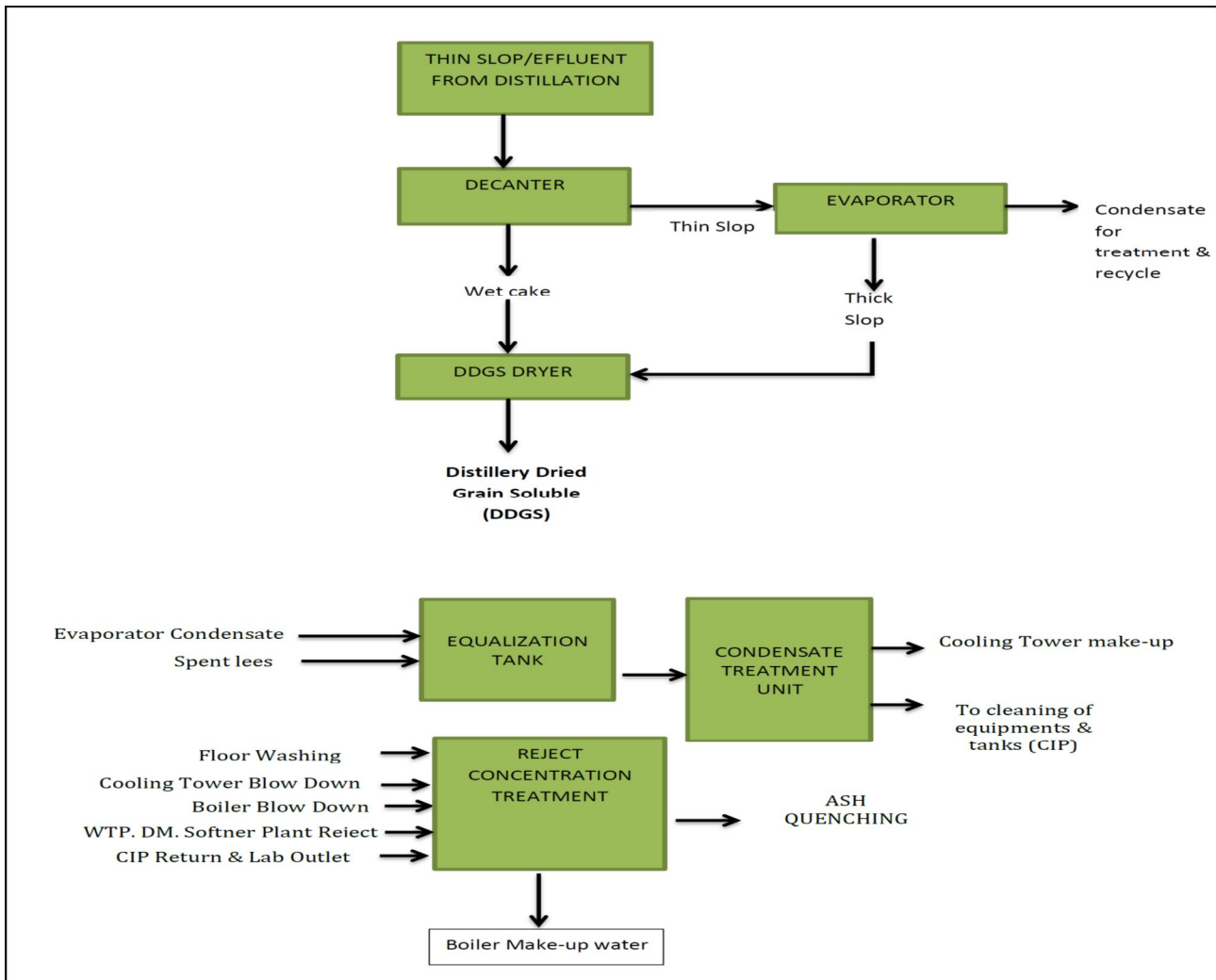
## Odour Management

- Odour shall be primarily controlled at source by good operational practices, including physical and management control measures.
- Better housekeeping will maintain good hygiene condition by regular steaming of all fermentation equipment.
- Use of efficient biocides to control bacterial contamination.
- Control of temperature during fermentation to avoid in-activation/killing of yeast.
- Avoid staling of fermented wash.
- Regular use of bleaching powder in the drains to avoid generation of putrefying microorganisms.

## Solid & Hazardous Waste Management

- Solid waste such as sludge from the effluent treatment plant shall be used as manure as it is non-hazardous.
- DDGS and Yeast sludge mixed in DDGS will be used as cattle feed / fish feed.
- Boiler Ash shall be used for brick manufacturing in future.

## ZERO LIQUID DISCHARGE SCHEME:



## GREENBELT:-

- Greenbelt area will be developed in the plant premises.
- The tree species to be selected for the plantation are pollutant tolerant, fast growing, wind firm, deep rooted.

## SOCIAL INFRASTRUCTURE:-

With the start of Construction phase, various employment opportunities will be generated. Many contractors will be benefited with contract works.

The Project site is well connected by road & is located near to the townships of Luwero with regular facilities for transportation; so workers will be able to commute to the plant from nearby locations. If required, company shall provide transportation from nearby places.

## LAND USE PLANNING:

Total land required 75.71 acres to Management. Following is breakup of land use,

<b>Particulars</b>	<b>Area (Acres)</b>
Built up area including storage & future expansion	17.31
Internal roads	5.56
Effluent treatment plant	0.12
Staff Housing & Parking area	3.15
Greenbelt	17.0
<b>Total</b>	<b>75.71</b>

## STORAGE, HANDLING & TRANSPORTATION OF PRODUCTS & CHEMICALS

### ANTIFOAM OIL:

High grade Silicone-based antifoam oil agents are considered in fermentation process to contain foaming tendencies. Antifoam oil shall be imported in TANZANIA in standard barrels (220 Ltrs) & will be transferred to covered stainless steel tanks for Dosing in the process area. Enzymes will be purchased in small carboys (35 Ltrs) & further stored in covered stainless steel tanks for dosing in the Process area.

### SULPHURIC ACID & CAUSTIC SODA

Since sulphuric acid and caustic soda which will be purchased in TANZANIA and ethyl Alcohol are dangerous goods, and if these goods are transported around in TANZANIA, the company shall make it necessary to display a description of the chemical substances and their hazards depending on their brands on the transport vehicles and containers in accordance with the United Nations Recommendations on the Transport of Dangerous Goods and rules, orders, directives and existing laws of TANZANIA on transportation

## PRODUCTS & BYPRODUCTS :

### POTABLE ALCOHOL, FUEL ETHANOL & IMPURE ALCOHOL:

All the products & by-products namely Potable Alcohol, Fuel Ethanol & Impure Alcohol are transparent in nature & colourless.



**POTABLE GRADE ALCOHOL**



**Fuel Ethanol / Impure Alcohol**

Final Packing for Potable Alcohol & Impure Alcohol shall be in 220 Ltr plastic drums or can be shipped directly without any packing in bulk chemical tankers. Picture as shown below:



**POTABLE ALCOHOL / FUEL ETHANOL / IMPURE ALCOHOL  
in drums/barrels**

DISTILLED DRIED GRAINS SOLUBLES: (DDGS)

DISTILLER'S DRIED GRAIN SOLUBLES (DDGS)

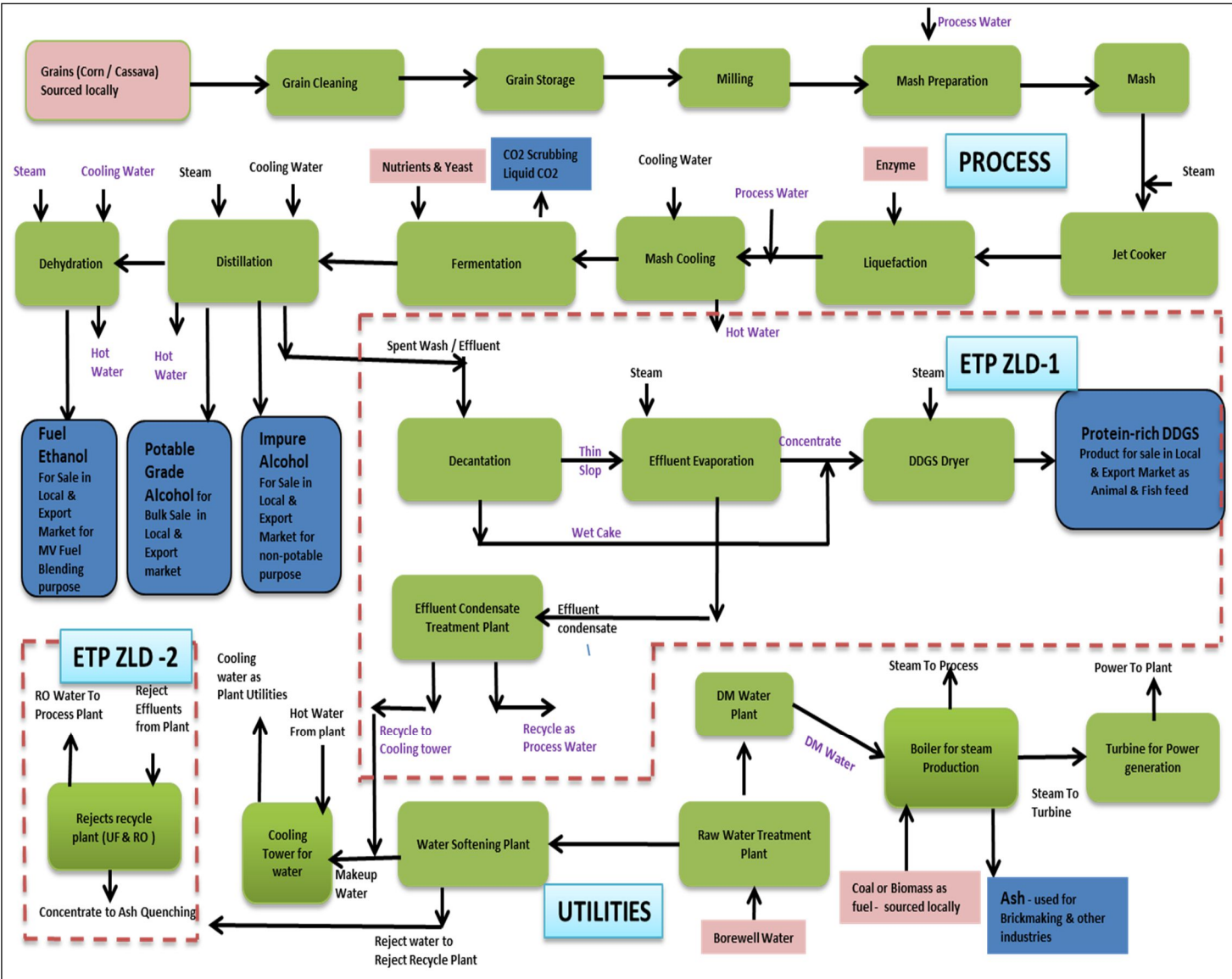


DDGS as By-product from the plant shall be packed in gunny bags & shall be sold in TANZANIA for Aquaculture (Fish Feed), Food for Poultry & Farm Animals



**CO2 Cylinders & Tanker (Beverage Grade & cryogenic applications)**

Complete Zero Liquid Effluent Discharge Plant (with ETP Recycle)





**Inputs / Raw Material to the plant**

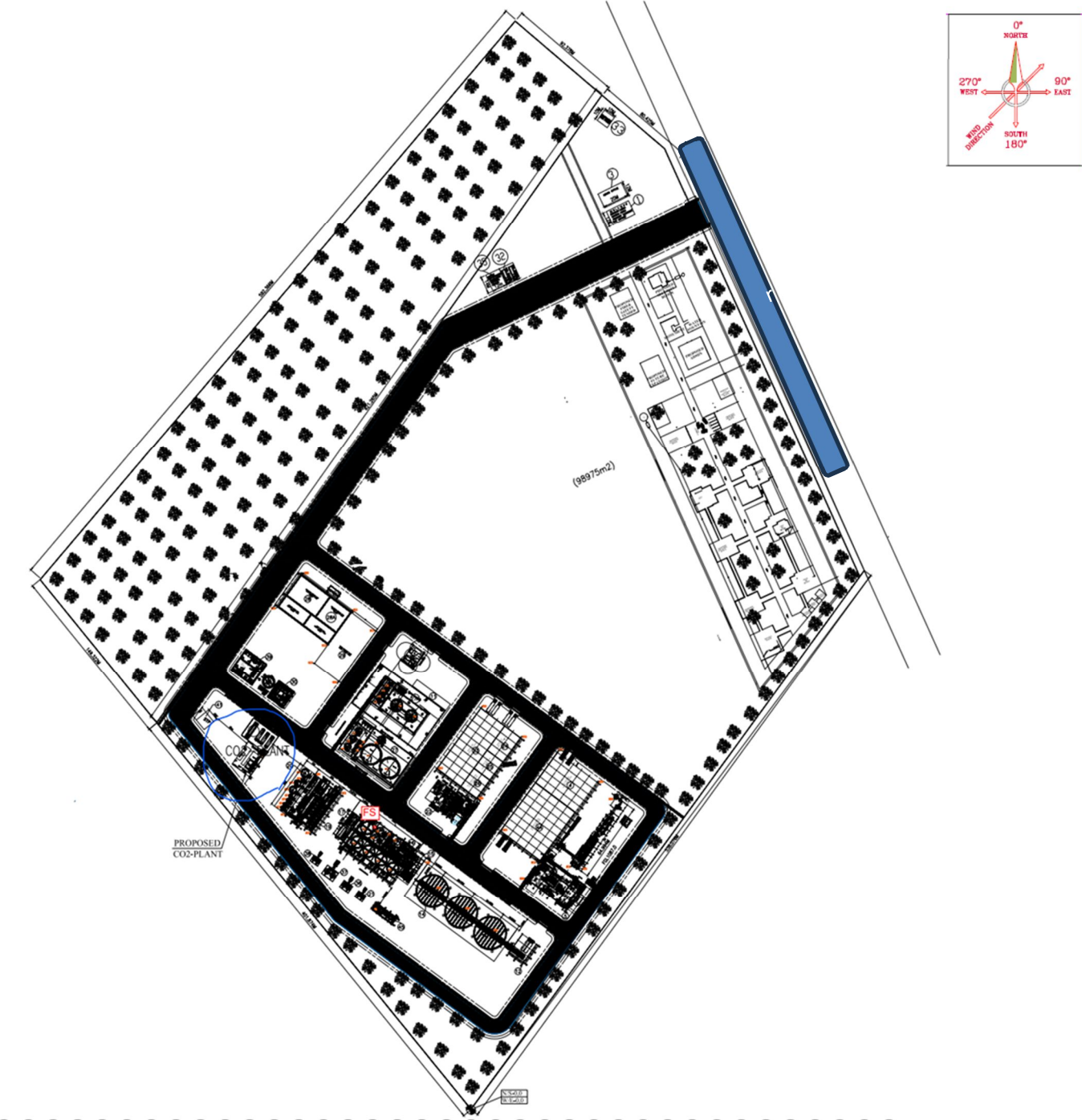


**Process blocks / Equipment sections**



**Output / Products & By-products from the plant**

PLANT LAYOUT



**PLANT SECTION-WISE DETAILS OF LAYOUT :**

Sr.No	DESCRIPTION	SIZE (Meter)(LXBXH)
1	SECURITY & TIME OFFICE	20 X 12 X 6
2	WEIGH BRIDGE	15 X 5
3	ADMIN OFFICE	20 X 12 X 5
4	COAL STORAGE	30 X 40 X 8
4A	BIOMASS STORAGE	50 X 40 X 8
5	PCC ROOM	10 X 10 X 6
6	BOILER	65 X 30 X 40
6A	ESP	
7	CHIMNEY	ø3 X 40
8	POWER HOUSE	30 X 30 X 20
9	D.G. SET WITH STACK	5 X 6 X 8
10	COOLING TOWER FOR TURBINE SECTION	5 X 4 X 7
11	EXTRA NUTRAL ALCOHOL DRUM FILLING STATION	27 X 20
12	GRAIN UNLOADING	15 X 15
13	GRAIN CLEANING	20 X 20
14	GRAIN STORAGE	70 X 32 X 30
15	GRAIN PROCESSING & MILLING SECTION	15 X 25 X 25
16	LIQUEFACTION & FERMENTATION SECTION	40 X 25
17	MCC ROOM FOR MILLING, LIQUIFICATION, FERMENTATION DISTILLATION & EVAPORATION	23 X 8 X 6
18	ENZYME, NUTRIENT & CHEMICAL STORAGE	4 X 2 X 6
19	DISTILLATION & INTEGRATED EVAPORATION SECTION	30 X 18 X 30
20	STANDALONE EVAPORATION & STRIPPER SYSTEM	30 X 20 X 25
21	COOLING TOWER FOR LIQUEFACTION SECTION	5 X 3 X 3
22	DECANTATION & DDGS DRYER	35 X 25 X 12
23	DDGS STORAGE	60 X 25 X 12
24	WORKSHOP FOR MECHANICAL, ELECTRICAL & INSTRUMENTATION	25 X 16 X 8
25	STORE ROOM	15 X 16 X 8
26	PACKAGING SECTION	20 X 16 X 8
27	EXTRA NEUTRAL ALCOHOL, ETHANOL & IMPURE SPIRIT STORAGE SECTION	60 X 50 X 12
28	RAW WATER, SOFT WATER & PROCESS WATER STORAGE TANK	35 X 52
29	WATER TREATMENT PLANT	50 X 25
30	EFFLUENT TREATMENT PLANT	50 X 30 X 6
31	FIRE WATER STORAGE TANK / FIRE FIGHTING PUMP SHED	35 X 20
32	FIRE TENDER ROOM	14 X 12 X 6
33	TRANSFORMER & GRID POWER STATION	10 X 10
34	HEAVY VEHICLE PARKING	327 X 49
35	SAFETY DEPARTMENT & EMERGENCY CONTROL CENTER	14 X 12
36	COOLING TOWER FOR FERMENTATION SECTION	10 X 6 X 4.5
37	COOLING TOWER FOR DISTILLATION SECTION	10 X 6 X 4.5
38	COOLING TOWER FOR STAND ALONE EVAPORATION & MSDH SECTION	10 X 6 X 4.5
39	CONDENSATE POLISHING UNIT (CPU)	20 X 20
40	ASH PIT	10 X 6
41	STP	10 X 10
42	MSDH SECTION	10 X 10
43	CO2 Section	22 X 17

**EQUIPMENT LIST (Details Attached Separately)**

S/no.	PARTICULARS
1	Grain Handling & Cleaning System
2	Grain Storage Silos & conveyors
3	Grain Mill
4	Jet Cooker
5	Fermentation Tanks
6	Distillation Columns
7	Evaporation Columns
8	Molecular Sieve Dehydration Columns
9	Decanters
10	Centrifugal Pumps, Positive displacement Pumps, Vacuum pumps, Screw Pumps
11	Dosing/Metering Pumps
12	Instrument Air Compressor
13	Cooling Towers
14	Plate Heat Exchangers
15	Shell-Tube Heat Exchangers - Condensers, Coolers, Heaters & Reboilers
16	Air Blowers & Twin Lobe Blowers
17	Agitators with motors
18	Drive Motors
19	Conveyors for Grain, Coal & DDGS
20	Buffer/Intermediate Storage Tanks - water, alcohol, mash etc
21	Steam Boilers & accessories
22	Turbines & accessories
23	Diesel Generators for auxiliary power
24	Gear Boxes
25	Trap / Strainers
26	Steam Pressure reducing stations
27	Valves type : Ball, Gate/ Globe, Butterfly, Actuated, Non-Return & Pressure Safety
28	Sand Filters & Carbon Filters
29	Ultrafiltration Membrane & Reverse Osmosis Membrane Units
30	Coal Crusher & Conveyors
31	Corn cobs, Baggasse shredders
32	Boiler Chimney
33	Electrostatic Precipitator for Flue gas
34	Cartridge filters
35	DDGS Bags filling machine
36	Drums filling station
37	Automatic liquid measuring & filling station
38	Weigh-bridge for trucks
39	Fire-fighting equipments & accessories
40	Pipes & Fittings
41	Electrical & Control Cables
42	Pipe & Cable Support structure

43 | CO2 Recovery Plant  
**3-DIMENSIONAL PLANT LAYOUT**



**Financials**  
**PROJECT CAPITAL COST**

Section	Cost USD
<b>Main Process Plant</b>	
Grain Handling & Storage Silos	\$ 6,780,000
Grain Milling	
Liquefaction	
Fermentation	
Distillation Section	
Dehydration Section	
Alcohol Storage Section	
CO2 Production Section	
<b>Utilities</b>	
Water Treatment Plant	\$ 4,957,000
Boiler	
Turbine	
Electrical	
Cooling Tower	
Fire Safety	
Laboratory Setup	
<b>Environment Management</b>	
Decanter for effluent	\$ 4,115,000
Condensate Stripping & Evaporation (Integrated & Standalone)	
DDGS Dryer Plant	
Effluent Treatment & recycle plant	
Electrostatic Precipitator & Chimney for Boiler flue gas exhaust	
Ash handling	
<b>Civil &amp; Structural</b>	
Structural supports for plant sections	\$ 700,000
Civil Construction (compound, Buildings, Roads, Foundations etc)	\$ 5,700,000
<b>Miscellaneous &amp; Services</b>	
Plant Installation	\$ 3,968,000
P&F, Transportation, Sea-freight, Material Handling at Ports etc.	
Technical Services (Project Management, Quality, Inspection, Audits)	
Fire Tenders, Trucks, Cars, Cranes & other items	
Contingency @8%	
<b>Total</b>	<b>\$ 28,317,600</b>

The current investment plan (capital contribution plan) is as follows:

<b>IN-CASH CONTRIBUTION (EXPENSES IN TANZANIA)</b>	
Civil Construction + 8% cont	\$ 6,156,000
<b>IN-KIND CONTRIBUTION (IMPORTS IN TANZANIA)</b>	
Plant + Utilities + Env + Installation + Technical Services + 8% Cont	\$ 22,161,600
<b>Total</b>	<b>\$ 28,317,600</b>

**RAW MATERIAL & OTHER REQUIREMENTS**

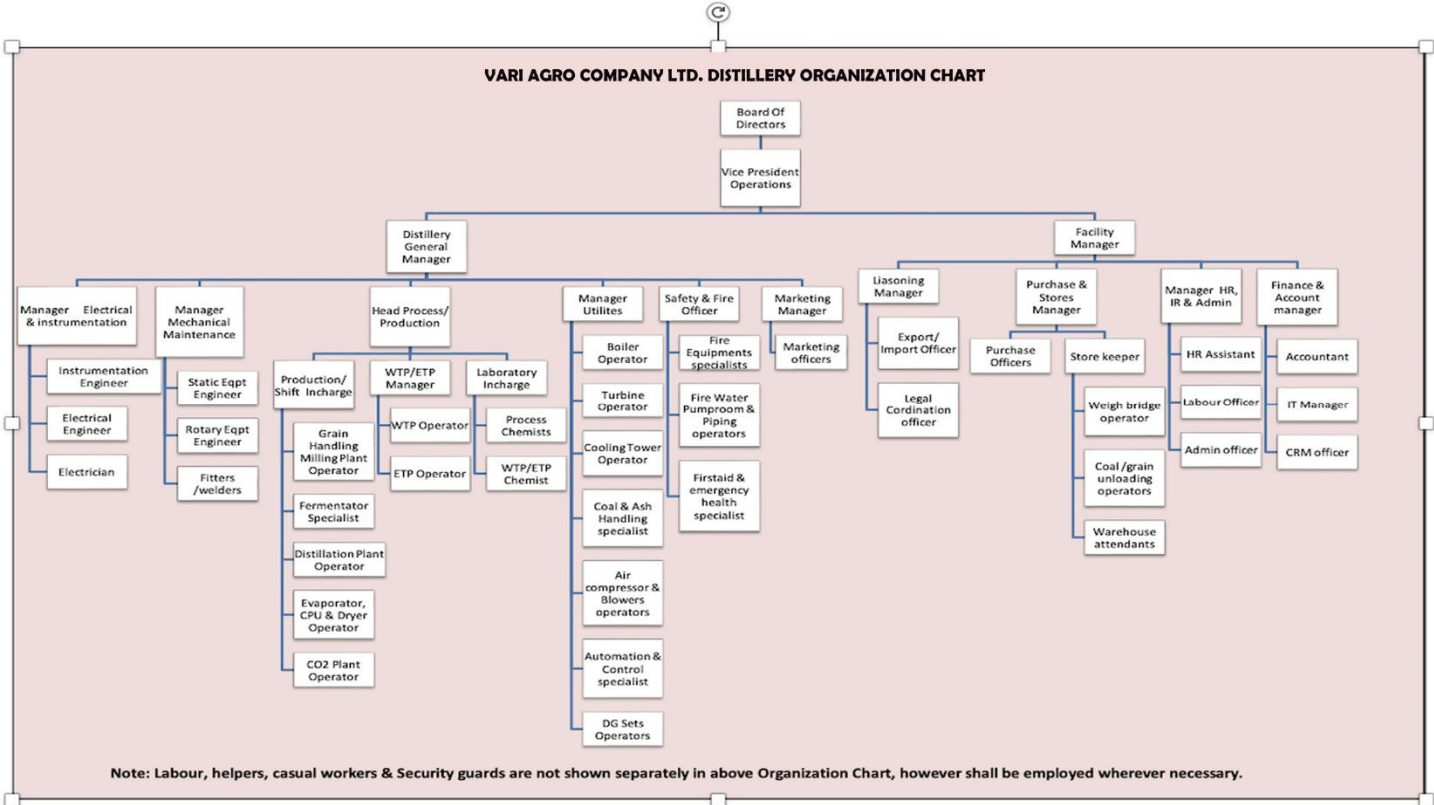
PARTICULAR	UNIT	QTY
<b>Plant Working Days</b>	<b>Days</b>	<b>330</b>
<b>Raw material - Corn</b>		
Production of Industrial Gr Alcohol / Day	Lit	95000
Production of Impure Spirit / Day @ 5%	Lit	5000
Total Alcohol Production	Lit	100000
Total Raw Material (Corn) required / Annum	MT	80242
Cost of Corn / MT	USD	\$ 230
Cost of Corn / Annum in USD	USD	\$ 18,455,617
<b>Process Chemicals</b>		
Antifoam Agent in Kg/ KL of Alcohol		0.50
Antifoam Agent in Kg/Annum		16500
Cost of Antifoam Agent in USD / Kg		\$ 2
Total Cost of Antifoam Agent in USD / Annum		\$ 33,000
<b>Enzymes</b>		
Alpha Enzymes in Kg/ KL of Alcohol		0.85
Alpha Enzymes in Kg/Annum		28050
Alpha Enzymes in USD / Kg		\$ 15.00
Total Cost of Alpha Enzymes in USD / Annum		\$ 420,750
Gluco Enzymes in Kg/ KL of Alcohol		1.30
Gluco Enzymes in Kg/Annum		42900
Gluco Enzymes in USD / Kg		\$ 15.00
Total Cost of Gluco Enzymes in USD / Annum		\$ 643,500
Caustic Soda in Kg/ KL of Alcohol		1.0
Caustic Soda in Kg/Annum		33000
Caustic Soda in USD / Kg		\$ 0.55
Total Cost of Caustic Soda in USD / Annum		\$ 18,150
Sulphuric Acid in Kg/ KL of Alcohol		0.5
Sulphuric Acid in Kg/Annum		16500
Sulphuric Acid in USD / Kg		\$ 1.00
Total Cost of Sulphuric Acid in USD / Annum		\$ 16,500
Dry Yeast in Kg/ KL of Alcohol		\$ 0.50
Dry Yeast in Kg/Annum		\$ 16,500
Dry Yeast in USD / Kg		\$ 15.00
Total Cost of Dry Yeast in USD/ Annum		\$ 247,500
<b>Total Cost for Raw Material &amp; Chemicals/ Annum in USD</b>		<b>\$ 19,835,017</b>

Note:

Raw Material : Corn or Cassava - shall be procured locally in TANZANIA market

Process Chemicals namely - Sulphuric Acid, Caustic Soda, Urea shall be sourced locally in TANZANIA Market while remaining chemicals namely Antifoam, Dry Yeast & Enzymes shall be imported from various countries.

ORGANIZATION CHART



TOTAL WORKFORCE DURING CONSTRUCTION : APPX 200

TOTAL WORKFORCE DURING NORMAL OPEARTION : APPX 140-180

**INPUT COSTS & PROPOSED SALE PRICE OF PRODUCTS & BYPRODUCTS**

ITEMS	COST
Raw Material Corn USD/ MT	\$210.00
Process water USD/M <sup>3</sup>	\$0.15
Soft water USD/M <sup>3</sup>	\$0.30
D.M. water USD/M <sup>3</sup>	\$0.35
Anti-foam USD/Kg	\$2.00
Alpha Enzymes USD/kg	\$15.00
Glucos Enzymes USD/Kg	\$15.00
Caustic Soda USD/Kg	\$0.55
Sulphuric Acid USD/Kg	\$1.00
Dry Yeast USD/Kg	\$15.00
Coal USD/MT	\$80.00

ITEMS	SALES VALUE
Sale of Potable Gr Alcohol @ 96.5% Purity USD/Lit	\$0.82
Sale of Impure Ethanol USD/Lit	\$0.65
Sale of DDGS USD/MT	\$130.00
Sale of DDGS UGX/MT	474,500
Sale of CO2 USD/MT	\$300.00
Sale of CO2 UGX/MT	1,095,000

**COST OF PRODUCTION**

PARTICULAR	UNIT	QTY
Plant Working Days	Days	330
Plant Capacity	Ltr/Annum	33,000,000
Annual cost of Raw Material & Chemicals		\$ 18,230,181
Total Plant Utilities (Water, Steam & Power)/ Annum in USD		\$ 4,460,651
Annual Cost of spare parts & maintenance in USD		\$ 627,000
Direct labour cost / Annum in USD		\$ 1,020,000
Total cost of Production in USD		\$ 24,337,832
Cost of Production of Potable Gr Alcohol/ lit	USD	\$ 0.78
Total cost of Production in USD @75 % Plant cap. In First Year.		\$ 18,253,374

**RAW MATERIAL PROCUREMENT PLAN**

Page 1	Operating Years , Cost				
	1	2	3	4	5
Distillery working days	330	330	330	330	330
Raw Material required / day MT	182	219	243	243	243
Total Raw Material required / Annum MT	60,181	72,218	80,242	80,242	80,242
Cost of Raw Material / UGX per MT	474,500	488,735	503,397	518,499	534,054
Cost of Raw Material / Anum in Mn. UGX	28,556	35,295	40,393	41,605	42,853
Total Cost of Raw Material Procurement per annum in Mn. UGX	28,556	35,295	40,393	41,605	42,853

Page 2	Operating Years , Cost				
	6	7	8	9	10
Distillery working days	330	330	330	330	330
Raw Material required / day MT	243	243	243	243	243
Total Raw Material required / Annum MT	80,242	80,242	80,242	80,242	80,242
Cost of Raw Material / UGX per MT	550,076	566,578	583,575	601,082	619,115
Cost of Raw Material / Anum in Mn. UGX	44,139	45,463	46,827	48,232	49,679
Total Cost of Raw Material Procurement per annum in Mn. UGX	44,139	45,463	46,827	48,232	49,679

**Note:- Inflation Considered is Flat 3 % every year.**

PROFITABILITY STATEMENT

Page 1	Operating Years				
Particular	First	Second	Third	Fourth	Fifth
Installed Capacity KLPD	100	100	100	100	100
Average Production Capacity %	75%	90%	100%	100%	100%
Potable Gr Alcohol Lit/Day	71250	85500	95000	95000	95000
Impure Alcohol Lit/Day	3750	4500	5000	5000	5000
DDGS produced MT/Day	52	62	69	69	69
CO2 Recovery / day	23	27	30	30	30
No. of shifts / day	3	3	3	3	3
Distillery working days	330	330	330	330	330
Potable Gr Alcohol Lit/annum	23512500	28215000	31350000	31350000	31350000
Impure Alcohol Lit/annum	1237500	1485000	1650000	1650000	1650000
DDGS produced MT/annum	17152	20582.0	22868.9	22868.9	22868.9
CO2 Recovery / annum	7425	8910	9900	9900	9900
Sales in USD	\$ 24,541,844	\$ 30,333,720	\$ 34,715,257	\$ 35,756,715	\$ 36,829,416
Cost Of Production in USD	\$ 18,253,374	\$ 25,067,966	\$ 25,820,005	\$ 26,594,606	\$ 27,392,444
Other manufacturing expences - Insurance	\$ 73,013	\$ 75,204	\$ 77,460	\$ 79,784	\$ 82,177
<b>COST OF PRODUCTION</b>	\$ 18,326,387	\$ 25,143,170	\$ 25,897,465	\$ 26,674,389	\$ 27,474,621
Add opening stocks of W.I.P.	\$ 55,479	\$ 74,369	\$ 91,920	\$ 105,198	\$ 108,354
Add opening stocks of F.G.	\$ 832,188	\$ 1,115,538	\$ 1,378,805	\$ 1,577,966	\$ 1,625,305
Less closing stocks of W.I.P.	\$ 74,369	\$ 91,920	\$ 105,198	\$ 108,354	\$ 111,604
Less closing stocks of F.G.	\$ 1,115,538	\$ 1,378,805	\$ 1,577,966	\$ 1,625,305	\$ 1,674,064
<b>Estimated cost of manufacture</b>	\$ 18,024,147	\$ 24,862,352	\$ 25,685,027	\$ 26,623,895	\$ 27,422,611
<b>C. Total cost of production</b>	\$ 18,024,147	\$ 24,862,352	\$ 25,685,027	\$ 26,623,895	\$ 27,422,611
<b>Net total income</b>	\$ 6,517,698	\$ 5,471,367	\$ 9,030,230	\$ 9,132,820	\$ 9,406,805
E. Total financial expences	\$ 0	\$ 0	\$ 0	\$ 0	\$ 0
F. Depreciation	\$ 2,019,168	\$ 2,019,168	\$ 2,019,168	\$ 2,019,168	\$ 2,019,168
G. Net Income	\$ 4,498,530	\$ 3,452,199	\$ 7,011,062	\$ 7,113,652	\$ 7,387,637
Profit Before Tax (P.B.T.)	\$ 4,498,530	\$ 3,452,199	\$ 7,011,062	\$ 7,113,652	\$ 7,387,637
IRR %	23.02				

Page 2	Operating Years				
Particular	Sixth	Seventh	Eighth	Ninth	Tenth
Installed Capacity KLPD	100	100	100	100	100
Average Production Capacity %	100%	100%	100%	100%	100%
Potable Gr Alcohol Lit/Day	95000	95000	95000	95000	95000
Impure Alcohol Lit/Day	5000	5000	5000	5000	5000
DDGS produced MT/Day	69	69	69	69	69
CO2 Recovery / day	30	30	30	30	30
No. of shifts / day	3	3	3	3	3
Distillery working days	330	330	330	330	330
Potable Gr Alcohol Lit	31350000	31350000	31350000	31350000	31350000
Impure Alcohol Lit	1650000	1650000	1650000	1650000	1650000
DDGS produced MT	22868.9	22868.9	22868.9	22868.9	22868.9
	9900	9900	9900	9900	9900
<b>Net sales in USD</b>	\$ 37,934,299	\$ 39,072,327	\$ 40,244,497	\$ 41,451,832	\$ 42,695,387
<b>Cost Of Production in USD</b>	\$ 28,214,217	\$ 29,060,644	\$ 29,932,463	\$ 30,830,437	\$ 31,755,350
Other manufacturing expences - Insurance	\$ 84,643	\$ 87,182	\$ 89,797	\$ 92,491	\$ 95,266
<b>COST OF PRODUCTION</b>	\$ 28,298,860	\$ 29,147,826	\$ 30,022,260	\$ 30,922,928	\$ 31,850,616
Add opening stocks of W.I.P.	\$ 111,604	\$ 114,952	\$ 118,401	\$ 121,953	\$ 125,612
Add opening stocks of F.G.	\$ 1,674,064	\$ 1,724,286	\$ 1,776,015	\$ 1,829,295	\$ 1,884,174
Less closing stocks of W.I.P.	\$ 114,952	\$ 118,401	\$ 121,953	\$ 125,612	\$ 129,380
Less closing stocks of F.G.	\$ 1,724,286	\$ 1,776,015	\$ 1,829,295	\$ 1,884,174	\$ 1,940,699
<b>Estimated cost of manufacture</b>	\$ 28,245,290	\$ 29,092,648	\$ 29,965,428	\$ 30,864,391	\$ 31,790,322
C. Total cost of production	\$ 28,245,290	\$ 29,092,648	\$ 29,965,428	\$ 30,864,391	\$ 31,790,322
<b>Net total income</b>	\$ 9,689,009	\$ 9,979,679	\$ 10,279,069	\$ 10,587,442	\$ 10,905,065
E. Total financial expences	\$ 0	\$ 0	\$ 0	\$ 0	\$ 0
F. Depreciation	\$ 2,019,168	\$ 2,019,168	\$ 2,019,168	\$ 2,019,168	\$ 2,019,168
G. Net Income	\$ 7,669,841	\$ 7,960,511	\$ 8,259,901	\$ 8,568,274	\$ 8,885,897
Profit Before Tax (P.B.T.)	\$ 7,669,841	\$ 7,960,511	\$ 8,259,901	\$ 8,568,274	\$ 8,885,897

The payback is expected to be 4 years 11 months.

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