EnviTec Biogas

Detailed Project Report
for
Biogas Power Plant + Organic Fertilizer Unit
in
Namakkal District, Tamil Nadu

CONTENTS

APPENDICES

1.0 EXECUTIVE SUMMARY

1.0 PROJECT BACKGROUND

UNDP, utilizing services of Development Alternatives (reputed NGO based in Delhi) evaluated the potential for Bio Energy and Organic Fertiliser in Namakkal District, which has around 600 poultry farms and around 20 million birds … apart from approximately 400,000 bovine animals and over 200,000 hectares of gross cropped land.

Grameena Abhivrudi Mandali (GAM) a Section 25 Company (refer website: www.gam-rd.co.in) carried out a study between October to December 2008 … with more specific motive of establishing Modular Biogas Plants + CHP (Combined Heat & Power unit) + Organic Fertilier unit.

Envitec Biogas India Pvt. Ltd (Indian JVC of EnviTec Biogas AG) refer website: www.envitec.co.in, provided technical support and engineering solutions for Biogas Power Plant + Organic Fertiliser unit.

2.0 PROJECT OVERVIEW

2.1 PROJECT MISSION

To undertake integrated Agriculture + Bio-Energy Projects through optimal ustilisation of locally available resources.

2.2 PROJECT OBJECTIVES

Would include the following

- Energy Component :

  Supply of Electricity from Biogas Engine + Thermal Energy through recovery of Biogas engine waste heat.

- Agricultural Component :

  Supply of Organic Fertilier (from digester effluent), facilitate establishment of feed lots for bovine animals (through ensilaging of forage crops/agricultural residues), and facilitate farmers undertaking cultivation of organic vegetables (through supplying organic fertilizer and establishing cold chain infrastructure).

2.3 PROJECT COMPONENT

For 6 units of 1 MW Biogas Power Plants (in 3 Blocks) would include the following

- 135,000 MT/year purchases of manure and agricultural residue/forage crops … resulting in higher income > 600 small farmers

- 45 million KWh Green Power exported to the grid

- 36,000 tons/year of Solid Organic Fertilizer + 72,000 KL/year of Liquid Fertilizer (containing dissolved ammonium and potassium) … providing coverage to 7200 hectares.

- 3 Nos. (cumulative capacity 360 TR) Cold Storages … as appropriate for vegetables farming.

2.4 PROJECT FINANCIALS OVERVIEW

- Total Investment : Euro 10 million
- Energy Revenues : Euro 3 million/year
- CER's Generation : 60,000/year

2.5 PROJECT FINANCING OVERVIEW

- Equity/Advance CDM funds
- MNRE/Government of India subsidy (initially financed through bridge loan from Bank)
- Debt (10 years from Plant Commissioning)

2.6 TECHNOLOGIES SELECTION

2.6.1 The Project proposes to use a wide range of locally generated Biomass (agri / industrial residues and animal waste) along with cultivation of energy crops.

Such residues have characteristics which make them unsuitable for firing in Boiler. At the same time they have high Cellulosic content and as such a good feedstock for Biogas Plants.

As such, biomethanation is a selected technology option.

2.6.2 For Biogas plants, technology from EnviTec Biogas AG will be used**.** EnviTec Biogas AG has established itself as one of Europe's leading biogas plant companies based on agricultural produce/waste. The plants will involve significant technological innovation as they will be the first Bio-gas plants, with unit size of 1063 KWe and having design PLF > 90 %, based on a combination of Industrial/Urban/Agricultural waste that is available in India.

2.7 KEY FAVOURABLE FACTORS OF THE PROJECT

- Replacement of fossil fuels & their migration of GHG emissions & Environmental Pollution.
- Market is created for presently unused / wasted commercially viable agri- products
- By-product from the biogas plants can be used as Liquid fertilizer

- Promotion of public-private partnership
- Creation of rural jobs

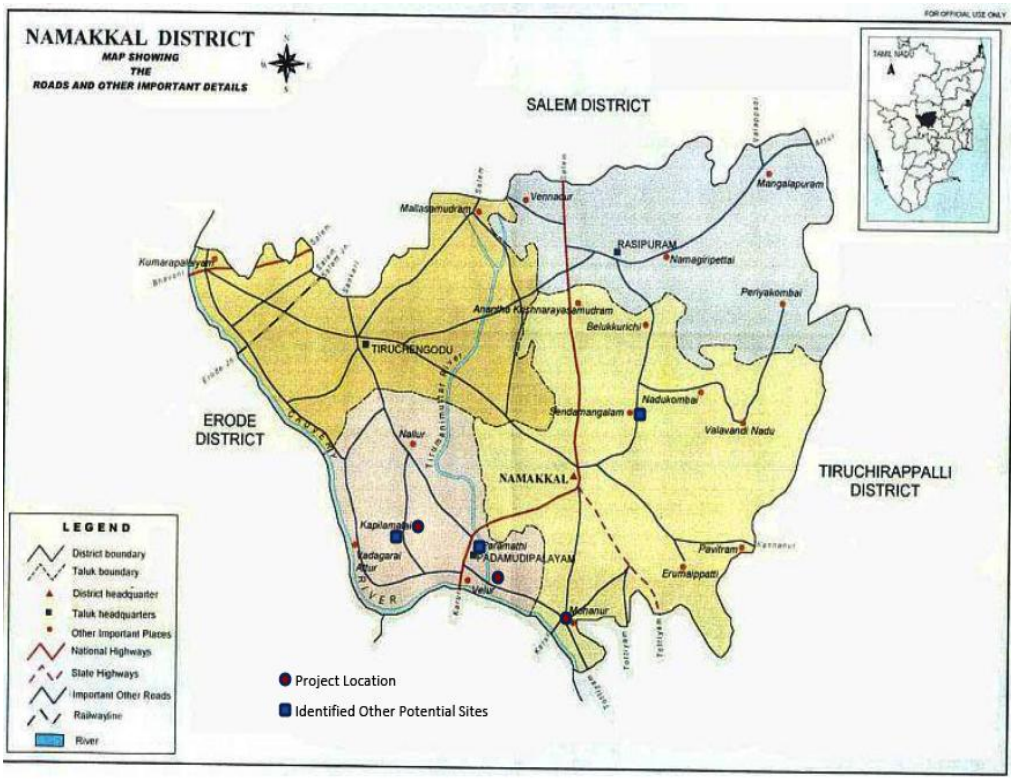
3.0 PROJECT LOCATION

3.1 The Project Phase I visualizes 3 clusters (each comprising 2 units of 1 MWe) located as follows

- 2 clusters in Mohanur Block (located at Mohanur and Nanjay Idayar Village)
- 1 cluster in Kabilarmalai Block (located at Kabilarmalai)

Additional 3 potential project sites have been identified for Phase II implementation.

Namakkal District map with selected project sites is given below.



4.0 SUSTAINABLE BIOMASS RESOURCE AVAILABILITY FOR BIOGAS PLANT

Namakkal District has significant agricultural activity with

- 176,544 hectares net cropped area and 205,689 gross cropped area.
- 396,064 bovine animals
- 19,455,327 poultry birds

Consequently, there is significant agricultural/animal waste generated viz.

- 978,608 MT/year of agricultural residues … out of which 650,788 MT is currently surplus
- 115,650 MT/year of cow dung.
- 350,195 MT/year of poultry waste.

There is also significant potential to support farmers in adopting alternate cropping (essentially forage crops such as Napier grass/CO_3, Sugar beet/Maize) … in over 100,000 hectares of land which is currently under cultivation for millets with yields between 1 to 1.2 MT/hectare. Supporting the farmers to increase yield of forage crops will ensure

- Higher earnings for farmers
- Superior feedstock for bovine animals
- Surplus forage crops as required for needs of Biogas Plant.

There is also the potential to increase horticultural crops, which will be facilitated through the organic fertilizer unit and VAM based cold storage (utilizing waste heat of Biogas engine) which are envisaged project components. Cultivation of horticultural crops will ensure

- Higher earnings to farmers
- Generation of horticultural waste which can be used as feed stock for Biogas Plant.

Broadly speaking the sustainable agricultural residues/forage crops and animal waste availability is more than adequate for the projected feedstock requirements of proposed Biogas Plants in the blocks.

5.0 2x1063 kWe BIOGAS POWER PLANT

The Biogas Plant comprises following ‘6’ main operating units

Operating unit 1: Biomass Reception/Storage & Substrate/feed Preparation

Operating unit 2: Fermentation and recirculation duct

Operating unit 3: Condensation Circuit

Operating unit 4: Residue storage tank

Operating unit 5: Gas utilization and lubrication oil station

Operating unit 6: Mechanical BOP/Electrical BOP/Civil

Process flow diagrams attached.

The gas engine would be of reputed International make eg. JMS 320 GS of GE Jenbacher with electric output of 1063 KWe.

6.0 ORGANIC FERTILISER UNIT

Approximately 48,600 KL/ year of digester effluent is produced which is superior quality organic fertilizer.
Advantages of using digester effluent as fertilizer are

a) General Positive impacts on environment:

- Decrease of odor of manure
- Less CH_4 emissions
- Reduce ground water contamination

b) Close nutrient cycle with using biogas plant effluent as fertilizer:

- Nutrients in feedstock of biogas plants can be reused after anaerobic digestion.
- Only few losses of nutrients during storage, transport and biogas process

c) Improvements on manure quality with anaerobic digestion:

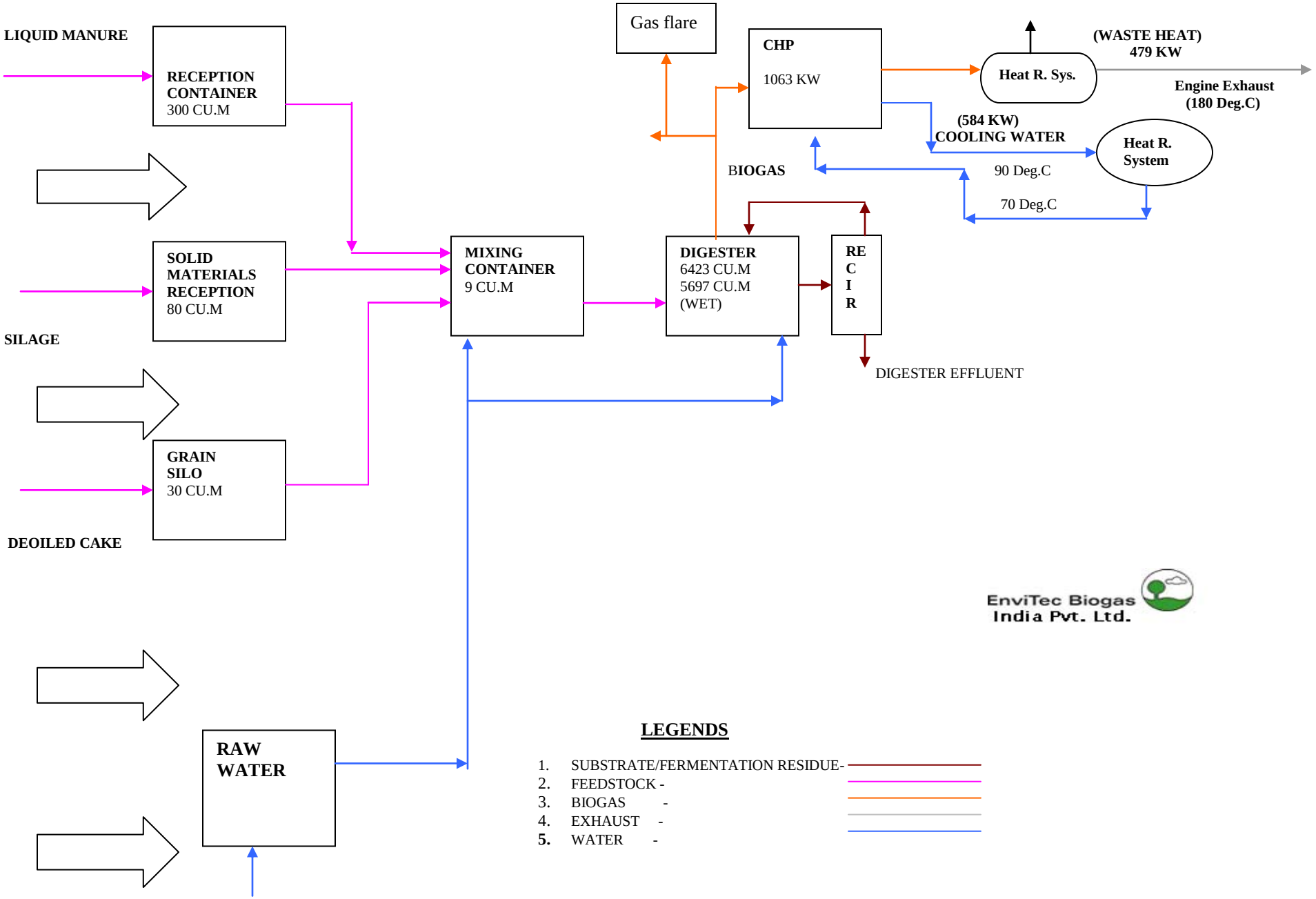
- Degradation of cells, organic acids and long chain organic matter
- Increase of availability of nutrients (especially nitrogen)
- Increase of humus on the fields (compared to combustion)

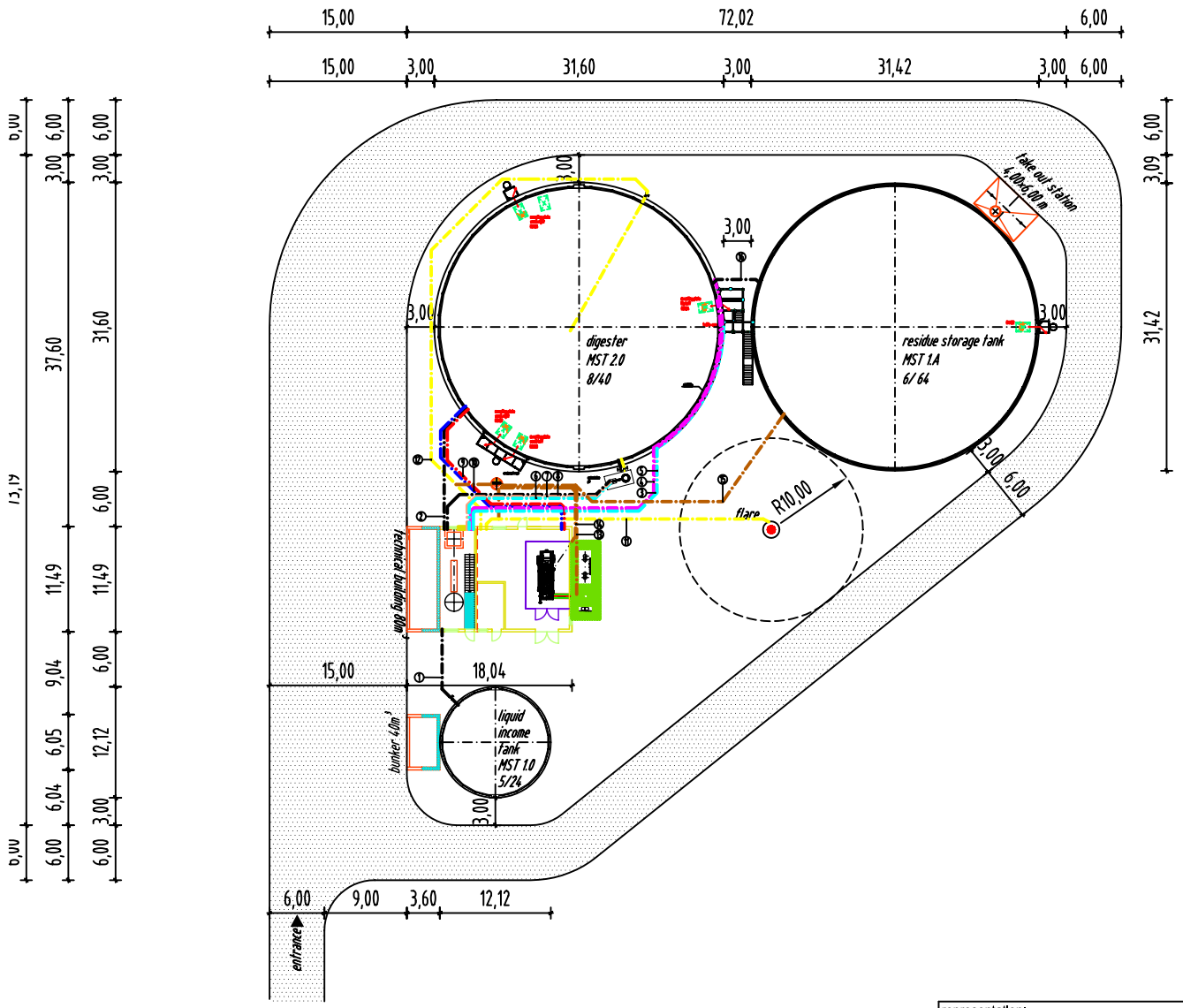
To enable assured quality of solid/liquid fertilizer … as well as reuse of water (and thereby minimize/avoid use of ground water) the organic fertilizer unit comprises solid separation and liquid treatment units viz.

- Screw press (or fabric filter)
- Flocculation system
- Centrifuge + Press sand filter (or pressure sand filter + micro filter)
- UF + RO Unit

Schematic for Organic fertilizer system is attached.

PROCESS FLOW DIAGRAM - BIOGAS PLANT





legend:

- existing puplic traffic surface
- planned public traffic surface
- planned private traffic surface
- existing private traffic surface
- existing residantial building, firm
- existing farm buildings, work building, immovable auxiliary building, garage etc
- planned structural facility
- green area
- outline of structural facilities
- delimitation of distance areas
- planned property border
- building border

representation: Layout plan - 1 MW

project/ owner: EnviTec India

deduction in advance

Wir geben Gas. EnviTec Biogas.

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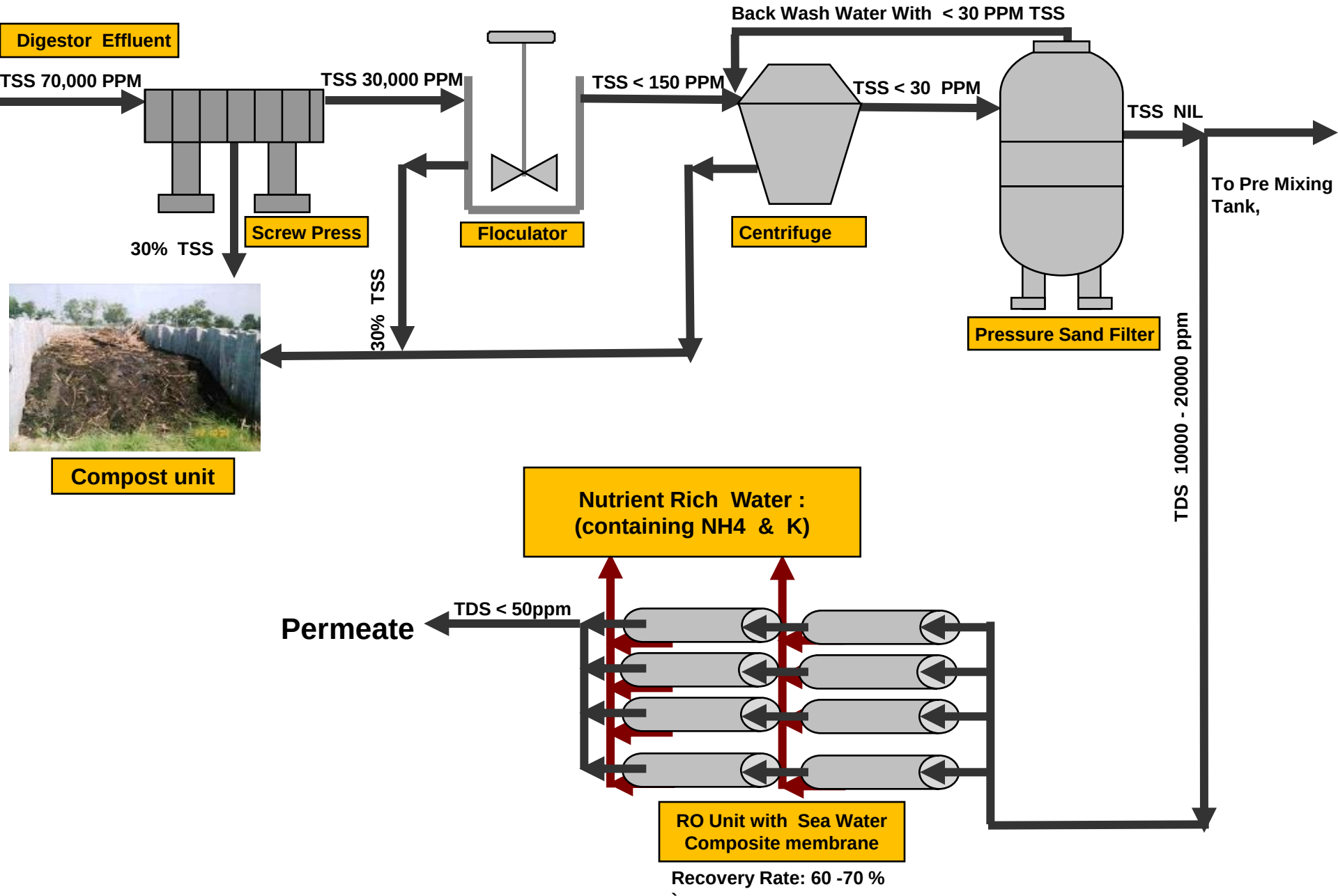
drawn: J. Bülter

drawing number: 08012.1.LP00/3-1

Schematic of Organic Fertilizer Unit



ANNEXURE -1

Project Implementation Schedule – EnviTec Biogas (I) Pvt. Ltd.													
		PERIOD IN MONTHS											
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2.6 Technologies Selection

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2.7 Key Favourable Factors of the Project

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- Market is created for presently unused / wasted commercially viable agri- products
- By-product from the biogas plants can be used as Liquid fertilizer
- Promotion of public-private partnership
- Creation of rural jobs

2.8 Key Contributions to Sustainable Development

- Creation of around 300 job opportunities in the biomass supply chain, organic manure plants & cold storages;
- Supply of power to TNEB and support to the electricity grid supply ensuring a stable power supply to the local areas.
- Contribution to organic farming through distributing to local farms the organic fertilizer that is generated as a residue from the Bio gas plant.

- Contributing to better earning for local farmers through providing alternate Crop options, viz (a) Forage crops with high yield *(b)* Horticultural produce, which is facilitated by the availability of local cold storage

2.9 Climate Change Impact Assessment

(a) Displacement of electricity from the grid by generating electricity from biogas with gas engines. The generated electricity will be sold to Tamil Nadu State Electricity Board grid.

(b) Cold storage operation with exhaust heat from biogas plants via vapor absorption machines and therefore substituting electricity from the electricity grid that would have been used to generate cold via vapour compression systems in the baseline case;

(c) The biomass waste used by the project activity would have been left to decay anaerobically in a solid waste disposal site without methane recovery in the baseline case. Hence, methane emissions are avoided.

2.10 Environment and Social Impact Assessment:

The environmental and social impacts of the project will be carried out by Grameena Abhivrudhi Mandali (GAM) a Section 25, not for profit, organization as per report structure given below;.

2.10.1 Environmental Assessment Procedure

(a) Collection of relevant data from various sources such as site visits by a surveyor to the proposed project area, interviews with various stakeholders identified by the project and collection of primary and secondary data from government records on agro-forestry, agriculture and agriculture related industries.

(b) A desktop review and compilation of this data.

(c) Environmental aspects (project activities that had potential to impact the environment) of the project will be identified. e.g. Emissions of flue gas from stack, fossil fuel emissions from transportation of biomass, generation of effluent from the water treatment plants *etc*.

(d) The environmental aspects will be prioritized based on their potential to have adverse impacts on the project environment and its stakeholders.

(e) Environmental management plans will be formulated, to control / manage / mitigate these impacts to the best extent possible. The primary aim of the environmental management plan will be to ensure that regulatory standards were met (also reflected in the Power Plant design) and that there exists appropriate monitoring procedures for collection of the relevant data.

2.10.2 Management of Potential Environmental Impacts

(a) The power plant and auxiliaries shall be ensured to meet the emission norms of the National Ambient Air Quality Standards (NAAQS).

(b) No radioactive emissions are expected from the proposed cogeneration plant.

(c) A green belt, of minimum 5 m width, shall be provided around the periphery of the power plant.

(d) Digested sludge from Biomethanation Plants will be collected in Tanks and utilized as Bio-fertilizers. No environmental hazards are anticipated from this.

2.10.3 Identification of Socio-economic aspects

Current socio-economic profile of the project area

a. Main income generating activities	
b. Main income generating assets	
c. Average Income of a Farmer from an acre of land per annum	
d. Average level of education	
e. Main types of local transport	
f. Locally available natural resources	

Based on the current socio – economic profile a detailed assessment will be conducted to identify the various potential socio-economic aspects related to the project. These aspects are as listed below:

- Production of quality and reliable power.
- Power generation through a renewable energy technology.
- Activities related to the biomass supply chain i.e. transportation, supply and preparation of biomass.
- Employment requirements at the project site

2.10.4 Socio-economic benefits that will be evaluated

- Increase in productivity of agricultural land and underutilized lands.
- Employment generation through sustainable biomass supply chain
- Grama Panchayats role and involvement.
- SHGs role and involvement.

- Employment generation through organic fertilizer unit and cold storage.
- Employment generation in Biogas Power Plant.
- Employment generation through growth of micro-enterprises, facilitated by availability of assured quality/reliable electric power
- Dissemination of information, to local community, on the advantages of renewable energy based technologies and their applications in creating local value-addition.
- In general, an improvement in the quality of life of the local people, living within the project boundaries.

2.11 Implementation Schedule

2.11.1 Project Development Schedule

The details of various clearances and permits required for the project are listed below.

- Clearance from the Local Panchayat and Local Municipal body.
- NOC from TNEB for Power Evacuation.
- Lease of Panchayati land
- Certificate of Incorporation of Project SPV
- Consent for Establishment and clearance from TN State Pollution Control Board.
- Subsidy approval from Ministry of New & Renewable Energy, Government of India and TN Renewable Energy Development Agency.
- Approval under the Indian Factories Act, 1948 from Chief Inspector of Factories.

2.11.2 Project Construction Schedule.

A total of 12 months after financial closure is envisaged for the construction of each cluster comprising two modular biogas plants (2X1063 KWe). An indicative Project Implementation Schedule is given below.

Totally 3 clusters are envisaged in Phase I of Project implementation.

The project also has very favourable assessment from view point of Climate Change impact, Environment and Social impact.

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3.0 PROJECT LOCATION

3.1 The Project Phase I visualizes 3 clusters (each comprising 2 units of 1 MWe) located as follows

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Additional 3 potential project sites have been identified for Phase II implementation.

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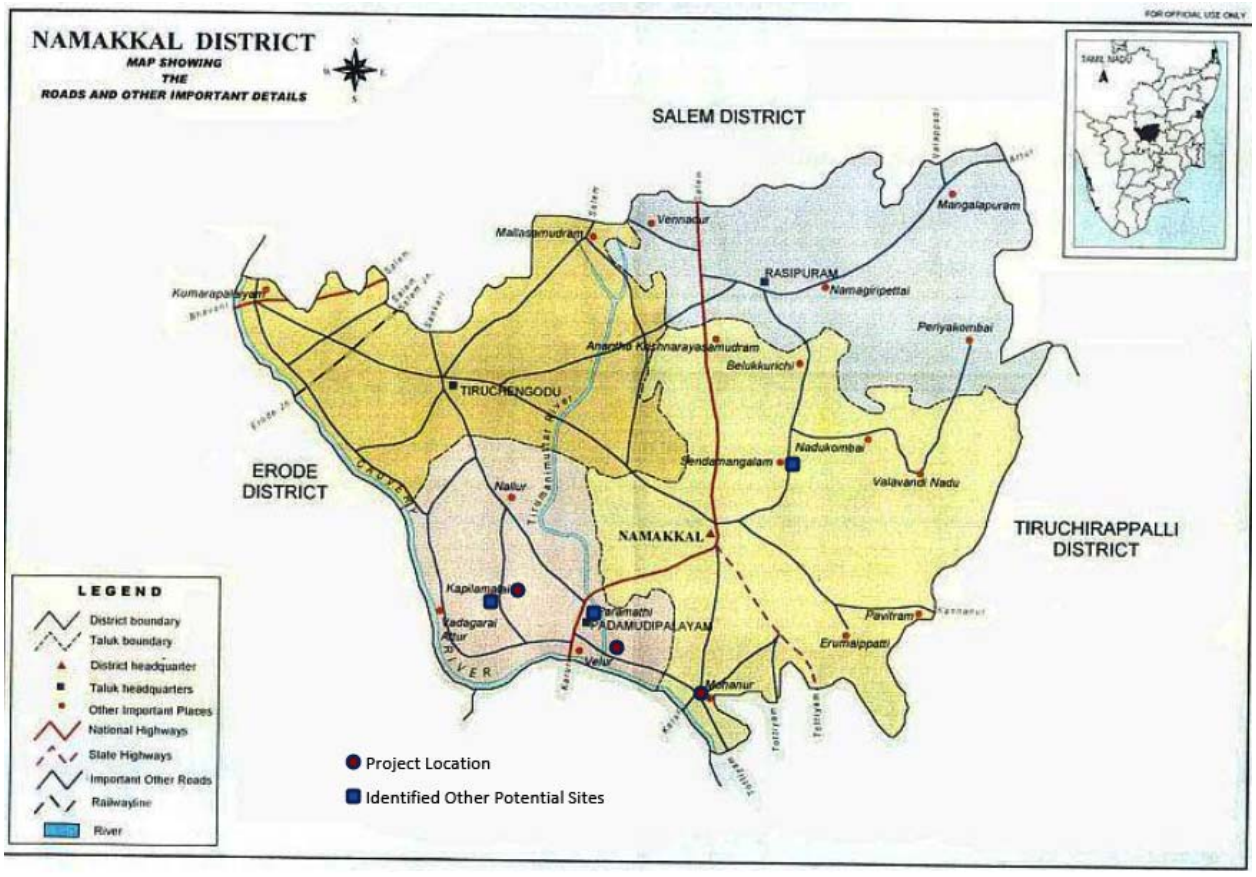

4.0 SUSTAINABLE BIOMASS RESOURCE AVAILABILITY FOR BIOGAS POWER PLANTS

4.1 SNAPSHOT OF BIOMASS RESOURCE AVAILABILITY IN NAMAKKAL DISTRICT

4.1.1 Land utilization pattern

Land utilization pattern in agriculture is shown in the table below;

Sl No.	Classification of land	Area, Ha	%age in Use
1.	Forest	43,909	13.0 %
2.	Net Cropping Area	176,544	53.0 %
3.	Permanent Pasture	6,684	2.0 %
4.	Misc. Tree Crops (Not included in Net sown area)	3,854	1.0 %
5.	Barren & Uncultivable	24,743	7.0%
6.	Fallow Land	37,518	11.0 %
7.	Land put on Non-Agricultural uses	38,302	12.0 %
8.	**Geographical Area**	**336,335**	**100 %**
9.	Area Sown More than once	29,145	8.6%
10.	Gross Cropping Area	205,689	61.6%

Source: Annual Report 07-08, Dist. Rural Development Agency, Namakkal

4.1.2 Cropping Pattern

Major crops cropping pattern is shown below

Crops	Cropping Pattern	
	Sowing	**Harvesting**
Paddy	Jun –Jul & Nov-Dec	Oct –Nov & Feb - Mar
Sugarcane	Jun – Feb	Nov - May
Tapioca	Jul-Aug	Apr - May
Maize	Jul – Aug & Nov - Dec	Nov – Dec & Mar- Apr
Sorghum	Jul – Aug & Nov - Dec	Nov – Dec & Mar- Apr

Source: Field survey by EBIL Team

4.1.3 Soil Classification

The details of soil type in various blocks of Namakkal District are summarized in the table below.

Sl No.	Block	Type of Soil	Remarks
1	Namakkal	Red Loam	Mineral rich
2	Puduchatram	Red Loam & Red Sandy Soil	Mineral rich
3	Sendamangalam	Clay loam	Sticky and holds more water. Good for perennial crops
4	Erumapatty	Black Soil & Clay loam	Good for irrigation
5	Mohanur	Black Soil	Good for irrigation
6	Kollihills	Lateritic Soil	Red soil. Good for perennial crops & short-term crops like vegetables.
7	Paramathy	Red Loam	Mineral rich
8	Kabilarmalai	Black Soil & Sandy coastal Alluvium	Good for irrigation
9	Tiruchencode	Red Loam	Mineral rich
10	Pallipalayam	Red Loam & Black Soil	Mineral rich & good for irrigation
11	Elachipalayam	Red Loam	Mineral rich
12	Mallasamudram	Red Loam	Mineral rich
13	Rasipuram	Red Loam	Mineral rich
14	Vennandur	Clay loam	Sticky and holds more water. Good for perennial crops
15	Namagiripet	Black Soil	Good for irrigation

Source: Dept of Agriculture, Namakkal. www.namakkal.tn.nic.in/agri.htm and EBIL Analysis

4.1.4 Area under Principal Crops

Principal crops cultivated in Namakkal District are Paddy, Millets, Sugarcane, pulses and oil seeds. Over the years there is a reduction in area of Rice, pulses and oil seeds while steady increase in area of Millets, sugarcane, Vegetables & Fruits. The details are summarized in the table below.

Area under principal crops (Lakh Ha)

No.	Crop	1997	1998	1999	2000	2001-05*	2004-05	2005-06	2006-07	2007-08
1	**Rice**	**0.25**	**0.24**	**0.25**	**0.22**	**0.13**	**0.09**	**0.19**	**0.27**	**0.21**
2	Sorghum	0.19	0.21	0.10	0.09	0.22	0.25	0.30	-	-
3	Maize	0.01	0.01	0.01	0.01	0.01	0.02	0.02	-	-
4	Tapioca	NA	NA	NA	NA	NA	NA	0.22	-	-
5	Other millets	0.06	0.05	0.04	0.04	0.02	-	0.01	-	-
	Total Millets	**0.26**	**0.27**	**0.15**	**0.14**	**0.25**	**0.27**	**0.55**	**1.11**	**1.20**
5	Red gram	0.09	0.09	0.08	0.10	-	0.01	0.01	-	-
6	Black gram	0,08	0.09	0.09	0.10	-	0.04	0.01	-	-
7	Green gram	006	0.06	0.07	0.08	-	0.09	0.04	-	-
8	Other Pulses	0.08	0.08	0.10	0.10	-	0.04	0.01	-	-
	Total Pulses	**0.32**	**0.32**	**0.34**	**0.38**	**0.20**	**0.18**	**0.07**	**0.24**	**0.19**
	Total Food Grain	**0.83**	**0.83**	**0.75**	**0.74**	**0.58**	**0.54**	**0.59**	**1.62**	**1.60**
9	Groundnut	0.80	0.76	0.68	0.73	0.50	0.48	0.48	-	-
10	Castor	0.12	0.11	0.10	0.13	0.02	0.03	0.03	-	-
11	Other Oilseeds	0.07	0.06	0.04	0.03	0.07	0.04	0.03	-	-
	Total Oil Seeds	**0.99**	**0.93**	**0.82**	**0.89**	**0.59**	**0.55**	**0.54**	**0.55**	**0.48**
12	Cotton	0.03	0.04	0.02	0.03	0.03	0.04	0.03	0.07	0.03
13	Sugar Cane	0.09	0.09	0.10	0.10	0.11	0.10	0.13	0.19	0.17
	Total	**1.93**	**1.89**	**1.69**	**1.76**	**1.31**	**1.23**	**1.54**	**2.43**	**2.28**
	Vegetables	-	-	-	-	-	0.21	0.26	0.29	NA
	Fruits	-	-	-	-	-	0.04	0.05	0.06	NA

Source: Dept. of Agriculture, Namakkal

4.1.5 Surplus Agricultural / Animal Waste Availability & DOC

A. Agriculture Crop Residues (Excluding bagasse generated at agro processing units)

Crop	Area, Ha	Crop Residue (MT)	Current Use, (MT)	Surplus (MT)
Paddy *	21,000	80,640	40,320	40,320
Sugarcane	17,000	170,000		170,000
Millets	120,000	240,000	120,000	120,000
Oil Seeds	48,000	115,968	58,000	57,968
Horticulture crops	35,000	525,000	262,500	262,500
Total	**241,000**	**978,608**	**480,820**	**650,788**

Source: Reputed NGO, Development Alternatives, New Delhi & EBIL Analysis

Note: Paddy Straw and Sorghum straw (50%) is used as dry fodder to the animals. However, most of the feed requirement to the animals is met through green fodder like Co-3, etc grown in their fields.

B. Animal & Poultry waste

Cow Dung

No. of Cattle	Waste Generation (MT/Yr.)
396,064	1,156,506

Poultry Waste

No. of Birds (Layers)	Generation (MT/ Yr.)
19,455,327	350,195

Source: Asst. Director of Statistics, Namakkal

4.1.6 Alternate Crops

- Farmers are growing Paddy in 10% of gross area cultivation i.e 21,000 Ha. Paddy is grown in irrigated areas only. In some of the areas particularly in River bed areas Net cross grass is grown as an alternate to Paddy since farmers will get an assured return.

- In 1, 20,000 Ha, Millets are grown to meet the needs of animal feed and food supply chain. Yield per hectare is found to be 1 to 1.2 MT which gives sub optimal earnings to farmers. There is a potential to convert portion of millets growing areas into alternate forage crops like Sugarbeet / Maize (Rotation crop) and Napier grass.

4.1.6 (a). Napier Grass:

Details of Napier Grass that was tested under trails by All India Coordinated Research Project on Forage Crops by Zonal Agricultural Research Station, VC Farm, Mandya, University of Agricultural Sciences, Bangalore.

Name of the crop & Species	Hybrid Napier (*Pennisetum typhoides x P purpureum*)
Name of the variety under which tested	CO-3
Source of Material in case of introduction	AIRP on Forage Crops, TNAU, Coimbatore
Recommended by Seminar/conference/workshop/state sub-committee	Recommended by - Annual Plant scientist Meet – 2008 between 22-24 Jan 08 at Mudigere, KA. - Pre-review workshop held at ZARS, VC Farm, Mandya on 8th Feb 08. - Annual ZREFC workshop of zone-6 held at ZARS, Mandya 6-7 Feb 08.
Its recommendations with specific justification for the release of proposed variety	The Napier Hybrid variety Co-3 is already popular among the farmers and hence it was endorsed for inclusion in package of practices instead of field trials.
Recommended ecology	Under protective irrigation
Description of the variety / Hybrid	Broad (80-95 cm long and 3-4.2 cm broad) and dark gren leaves, semi erect, profuse tillering, quick regeneration, high green forage yield and leaf: stem ration with good palatability
Distinguished morphological trials	
Plant height	135.1 cm
Growth habit	Semi erect
Leaf waviness	More
Tillering	Profuse tillering
Mid rib	Soft and thin
Leaf hairiness	Dense hairs at the bottom of the leaves
Leaf of color	Dark green
Leaf breadth	Broader leaves
Maturity (Range in No. of days)	Vegetative propagated by stem cuttings and root slips, can be kept in the field for 3-

	4 years and harvested every 45 days
Maturity Group (Early/Medium/late) wherever such classification exists	Perennial Grass
Reaction to major diseases and pests under field and controlled condition	No major pests and diseases noticed
Agronomic Features	
Time of planting	June – July
Seed rate	20,000 root slips / cuttings / ha
Spacing	90cm x 60cm
Lodging	No lodging
Fertilizer level	225:150:100 NPK kg/ha
Qualitative of produce including nutritive value	Crude protein yield (q/ha) : 15.1 ADF% : 32.4 NDF% : 44.4 IVDMD% :61.6
Reaction to stress	Tolerant to moisture stress
Yield data	
Station Trial at Mandya	139.2 Tons /Ha
MLT during 2007-08 for green forage yield	135.9 Tons / Ha
Average yield under normal conditions	125 – 140 Tons / Ha
Data on other Characteristics	
Plant Height	135.1 Cm
Leaf Stem Ration	1.6
Dry Matter Yield	20.85 Tons / Ha
Per day Dry matter production	0.011 tons/ha/day
Per day Green Forage production	0.45 Tons/Ha/Day
Agency Responsible for maintaining nucleus and breeder seed	AICRP on Forage Crops, ZARS, VC Farm, Mandya
Information on accessibility of the variety by farmers / consumers / industry	Highly accepted by the farmers, Milk Cooperatives and SHGs
Any other pertinent information	Puts on profuse vegetative growth throught the year and flowers only during Rabi. Hence the leaf: stem ration us very high conferring high palatability and less rejection by the cattle.
Current approximate percentage of area of the crop under this variety in Karnataka state	20%
Recommendation of the All India workshop about the variety	The variety Co-3 recorded high green forage yield in coordinated trials but it was notified for release in Tamil Nadu by the State Variety Release Committee.

Note: Chemical Fertilizer application will be reduced through application of assured quality Organic manure.

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4.1.6 (b) Sugarbeet *(Beta vulgaris spp. Vulgaris var altissima Doll*)

Sugar Beet is a temperate crop and initially was cultivated in cold countries, where Sugarcane was not feasible. Lately, a few countries in sub-tropics took up to Sugarbeet cultivation. Syngenta has been able to tropicalize the same for its cultivation virtually in areas with latitudes up to 26^{o}.

On the basis of agronomic trials' at various locations in India, Tropical Sugarbeet has been found to be a useful crop for farmers in plains of Tamil Nadu, Karnataka, Rajasthan, Andhra Pradesh, Punjab, Haryana, Uttar Pradesh and Maharashtra. In a good climate, they can expect to achieve 80 MTs / hectare. Besides the source of sugar (16 to 18 %) Sugarbeet provides several useful by-products. Pulp, a factory product is also used as a cattle feed and molasses is used by pharmaceutical industry.

In India, Sugarbeet can be cultivated as a supplementary crop to augment sugar production. The factories will have to create additional infra-structure for beet washing, slicing, diffusion and clarification of the juice by carbonation process. The other machinery of the present sugar factories can be utilised for the further processes in sugar production. The extra bagasse produced by the present sugar factories can provide the fuel required for Sugarbeet processing.

Moreover, Sugarbeet juice can directly be fermented for ethanol production in the present molasses based distilleries. Because of the permission granted by Government of India to mix ethanol in the petrol up to 5 %, the demand for ethanol has increased tremendously. Tropical Sugarbeet is a relatively short duration (5 to 6 months) crop and hence can be fitted in the prevalent crop rotation. It is also found to be a salt tolerant crop and can be grown in the saline-alkaline soils. Large patches of saline and alkaline soils have been developed in the Sugarcane belt as a result of indiscriminate use of fertilizers and irrigation water. Such fallow lands can be utilized for Sugarbeet cultivation.

Syngenta India Limited, a Pune based multi-national Seed company through its adaptive trials have identified three hybrids suitable for the agro-climatic conditions in India and offers following advantages.

1. Sugar beet *(Beta vulgaris spp. Vulgaris var altissima Doll)* is a short duration crop 5 – 6 months.
2. Moderate water requirement i, e. 30 – 40% of cane.
3. Fertilizer requirement is also 30 – 40% of cane.
4. High sucrose content of 14 –18%.
5. Improves soil condition.
6. Excellent rotational crop for enhancing the yield of the next crop.
7. Sugar beet can be grown in saline & alkaline soils.
8. Easy for harvesting.
9. Sugar beet yield is 80 MT / Ha.

Sugarbeet Cost of Cultivation (as prescribed by Synzenta for 2007-08)

Sl No.	Particulars	Cost / ha, Rs.
1	Preparatory Tillage	2,625
2.	Sowing of Sugarbeet	6,251
3.	Fertilizer	6,493
4.	Weed Control	3,600
5.	Gap filling & Thinning	1,200
7.	Irrigation	1,800
8.	Land revenue & Canal irrigation charges	250
9	Pest & Disease management	700
10	Harvesting	3500
11.	Management watch & Supervision	1200
12.	**Total Cost of cultivation**	**27,619**
13.	Returns to farmer for land ownership	25,000
14.	**Total Cost**	**52,619**

Note: (1) The above cost worked out for crop cycle of 6 months.

(2) Second crop could be maize silage /corn for which provision of Rs. 12,500 / Ha is made towards returns to farmer for land ownership

(3) Consequently, assured net returns to farmer is Rs. 37,500 /Ha.

4.2 SURPLUS AGRICULTURAL / ANIMAL WASTE AVAILABILITY IN MOHANUR BLOCK

4.2.1 Land Utilisation Pattern

Classification	Area, Ha
Geographical Area	26,200
Non-Agricultural Land	3,126
Uncultivable waste Land	3,921
Cultivable waste land	756
Permanent Pasture	1,005
Fallow Land	3,990
Net cultivable area	**13,202**

Source: Dept. of Agriculture, Mohanur

4.2.2 Source-wise Irrigation

Irrigation Source	Area, Ha
Canals	3,900
Open wells	4,862
Tube Wells	632
Lift irrigation (16 Societies)	1,715
Total	**11,109**

Source: Dept. of Agriculture, Mohanur

4.2.3 Major Crops Grown

Crops	Area, Ha	Cropping Pattern	
		Sowing	Harvesting
Paddy	3,000	Jun –Jul & Nov-Dec	Oct –Nov & Feb - Mar
Sugarcane	2,200	Jun – Feb	Nov - May
Tapioca	476	Jul-Aug	Apr - May
Maize	3,200	Jul – Aug & Nov - Dec	Nov – Dec & Mar- Apr
Sorghum	2,700	Jul – Aug & Nov - Dec	Nov – Dec & Mar- Apr
Oil Seeds	404	Jul – Aug	Nov – Dec & Feb – Mar (Multiple crops)
Horticulture Crops	1,222		
Total	**13,202**		

Source: Dept. of Agriculture, Mohanur and Field survey

4.2.4 Horticulture Crops

Fresh Fruits Crops	Area, Ha
Banana	467
Mango	73
Sapota	34
Papaya	10
Sub-Total	**584**
Vegetables	
Brinjal	138
Bhendi	128
Onion	54
Tomato	119
Other Vegetables	50
Sub-Total	**965**
Spices & Condiments	66
Medicinal Crop	56
Flowers	27
Total	**1,222**

Source: Dept. of Horticulture, Mohanur

4.2.5 Surplus Agricultural / Animal waste Availability in Mohanur Block

A. Agriculture Residue

Crop	Area, Ha	Crop Residue (MT)	Current Use, (MT)	Surplus (MT)
Paddy	3,000	23,040	11,520	11,520
Sugarcane	2,200	22,000	--	22,000
Tapioca	476	NA	NA	NA
Maize	3,200	12,800	6,400	6,400
Sorghum	2,700	10,800	5,400	5,400
Oil Seeds	404	970	--	970
Horticulture Crops	1,222	18,330	9,000	9,330
Total	**13,202**	**87,940**	**32,320**	**55,620**

Source: Dept. Agriculture, Mohanur & EBIL Analysis

B. Animal & Poultry waste

Cow Dung

No. of Cattle	Waste Generation (MT/Yr.)
6,696	24,440

Poultry Waste

No. of Birds (Layers)	Generation (MT/ Yr.)
3,199,000	57,582

Source: Dept. Animal Husbandry, Namakkal

4.2.6 Alternate crops

Organic fertilizer will be supplied to agricultural land that is currently under cultivation for Maize / Sorghum which is anticipated to significantly increase current yield levels.

Around 15% of this area could be converted to cultivation of forage crops (Sugarbeet / Maize and/ or Napier Grass) ….producing around 100,000 MT of silage annually as feedstock for bovine animals and surplus used as feedstock for Biogas plants.

4.2.7 Sustainable availability of Biomass

The requirement of feedstock for 2 clusters of 2 x 1063 kWe Biogas Plants and currently available sources of sustainable biomass supply are summarized below

Feedstock	Required Quantity for 2 x 1063 kWe Biogas Power Plant (MT/Yr)	Sustainable Availability (MT/Yr.)
Silage of Agri. Residues / Forage crops & Manure	90,000	237,642

4.3 SURPLUS AGRICULTURAL/ ANIMAL WASTE AVAILABILITY IN KABILARMALAI BLOCK

4.3.1 Land Utilisation Pattern

Classification	**Area, Ha**
Geographical Area	21,428
Non-Agricultural Land	1,919
Uncultivable waste Land	1,976
Cultivable waste land	626
Permanent Pasture	816
Fallow Land	3,017
Misc. tree Crops	89
Net cultivable area	**12,985**

Source: Dept. of Agriculture, Kabilarmalai

4.3.2 Major Crops Grown

Crops	**Area, Ha**	**Cropping Pattern**	
		Sowing	**Harvesting**
Paddy	2,500	Jun –Jul & Nov-Dec	Oct –Nov & Feb - Mar
Sugarcane	4,000	Jun – Feb	Nov - May
Tapioca	200	Jul-Aug	Apr - May
Maize	2,200	Jul – Aug & Nov - Dec	Nov – Dec & Mar- Apr
Ground Nut	4,024	Jun – Jul & Nov –Dec	Sept - Oct & Feb - Mar
Total	**12,924**		

Source: Dept. of Agriculture, Kabilarmalai

4.3.3 Surplus Agricultural / Animal waste Availability in Kabilarmalai Block

A. Agriculture Residue

Crop	Area, Ha	Crop Residue (MT)	Current Use, (MT)	Surplus (MT)
Paddy	2,500	19,200	9,600	9,600
Sugarcane	4,000	40,000	---	40,000
Tapioca	200	NA	NA	NA
Maize	2,200	8,800	4,400	4,800
Ground Nut	4,024	15,452	7,726	7,726
Total	**9,400**	**83,452**	**21,726**	**62,126**

B. Animal & Poultry waste

Cow Dung

No. of Cattle	Waste Generation (MT/Yr.)
8,087	29,517

Poultry Waste

No. of Birds (Layers)	Waste Generation (MT/ Yr.)
2,289,700	41,214

Source: Dept. of Animal Husbandry, Namakkal

4.3.4 Alternate Crops

Organic fertilizer will be supplied to agricultural land that is currently under cultivation for Maize / Tapioca which is anticipated to significantly increase current yield levels.

Around 15% of this area could be converted to cultivation of forage crops (Sugarbeet / Maize and/ or Napier Grass) producing around 45,000 MT of silage annually as feedstock for bovine animals and surplus used as feedstock for Biogas plants.

4.3.5 Sustainable Availability of Biomass

The requirement of feedstock for 1 cluster of 2 x 1063 kWe Biogas Plants and currently available sources of sustainable biomass supply are summarized below

Feedstock	Required Quantity for 1 x 1063 kWe Biogas Power Plant (MT/Yr)	Sustainable Availability (MT/Yr.)
Silage of Agri. Residues / Forage crops	45,000	177,767

5.0 2 x 1063 kWe BIOGAS POWER PLANT

5.0 BIOGAS POWER PLANT (2 X 1063 kWe)

Biomass Power is generated by fermenting items like Agricultural Residues, Forage crops, Horticulture waste, Animal waste, De-oiled cakes, Municipal Solid Waste etc., (***Biomethanation Process***) in large Digester to produce Biogas which can be fired in Special Gas Engine - Alternator set that produce electricity.

5.1 Biomethanation:

Biomethanation is the process of conversion of organic matter in the Substrate to Biomethane (commonly referred to as biogas) and effluent (good Quality manure) by microbial action in the absence of air, known as "anaerobic digestion"
Biogas is a high quality fuel, can be used for cooking, lighting, running dual fuel engines for agro-processing, pumping water and generating electricity. Similarly the slurry can be used as fertilizer, feeding fish and animals, mushroom cultivation, earthworm cultivation and so on. Thus the advantages of biogas are good quality fuel and fertilizer, environmental pollution control, environmental sanitation through toilet attachment and drudgery reduction.

5.2 EnviTec Biogas India Private Limited (EBIL):

EnviTec Biogas India Pvt. Ltd (EBIL) is established as a joint venture company between EnviTec Biogas AG, Germany & MPPL Renewable Energy Pvt. Ltd., India.

MPPL Renewable Energy Pvt. Ltd. (MPPL) is pioneered in using the low density crop residues as primary fuel for generation of electricity. The Company has emerged as a leader in Modular Biomass Power Plants coupled with sustainable development initiatives (website www.mpppl.com)

EnviTec Biogas AG is a global leader for Biogas plants based on agricultural produce / waste. EnviTec has to its credit the world's largest biogas park with an electrical connected load of 20 MW. EnviTec built biogas plants are operating with > 90% PLF (website www.envitec.co.in).

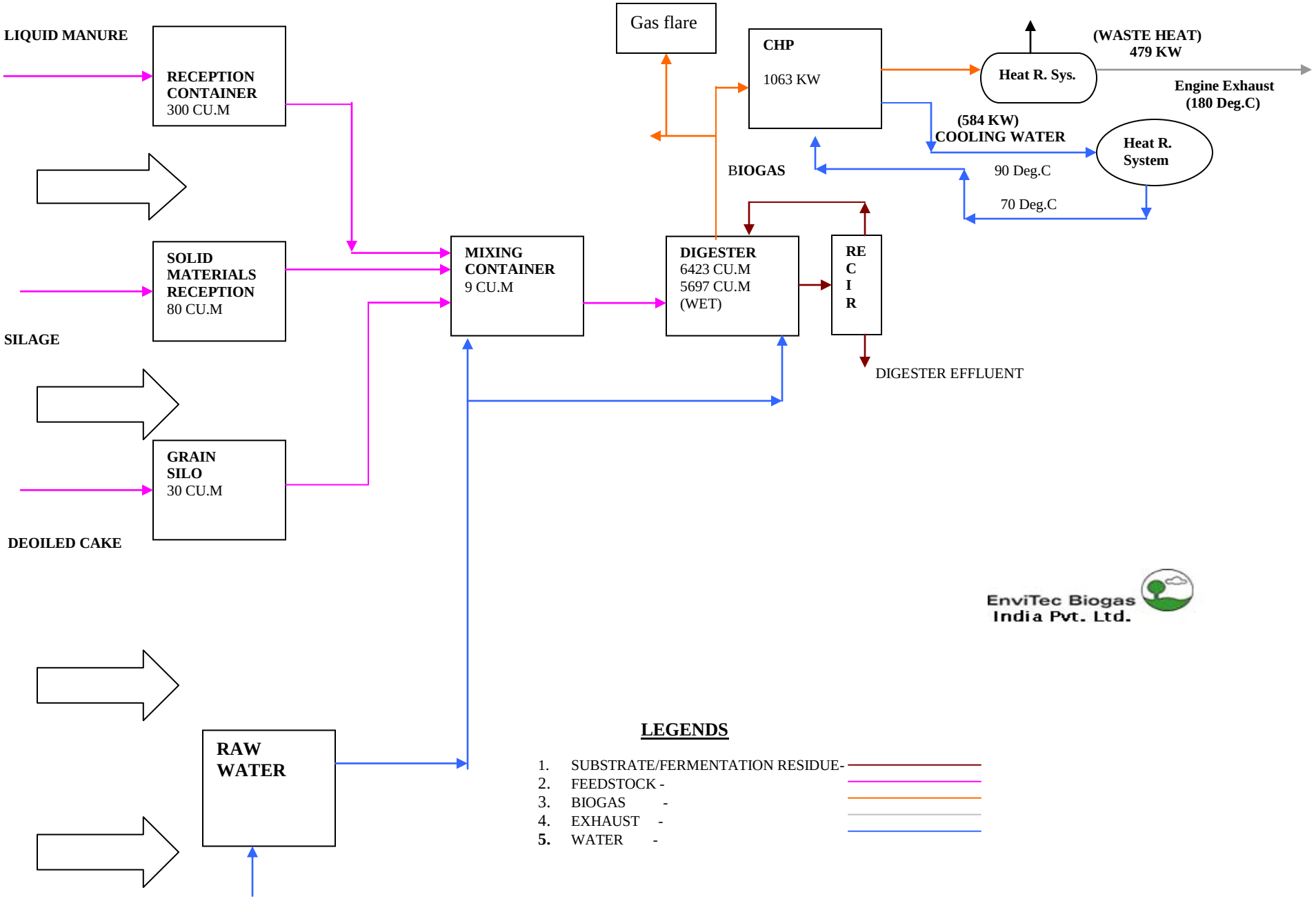
5.3 Biogas Power Plant Specification:

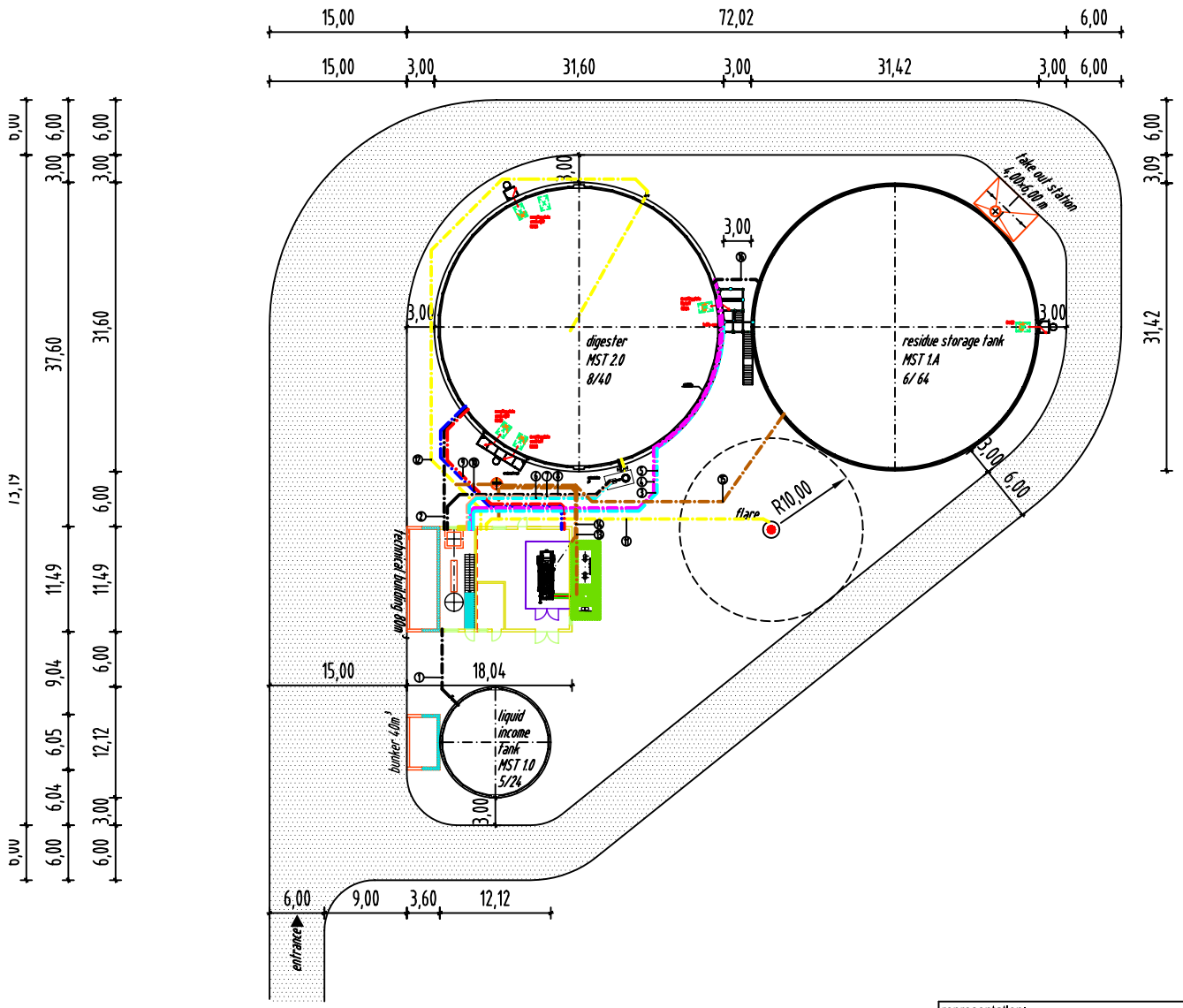
The 2 x 1063 kWe Biogas power plant consists of 2 Nos Modular EBIL solution comprising 12,500 M^3 /day Biogas plant + 1063 kWe Gas Engine Alternator set of reputed make (eg. JMS 320 of GE Jenbacher)

Attached are

- Process Flow Diagram
- Plant Layout Diagram
- Technical Data Sheet

PROCESS FLOW DIAGRAM - BIOGAS PLANT





legend:

- existing puplic traffic surface
- planned public traffic surface
- planned private traffic surface
- existing private traffic surface
- existing residantial building, firm
- existing farm buildings, work building, immovable auxiliary building, garage etc
- planned structural facility
- green area
- outline of structural facilities
- delimitation of distance areas
- planned property border
- building border

representation: Layout plan - 1 MW

project/ owner: EnviTec India

deduction in advance

Wir geben Gas. EnviTec Biogas.

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project number: 08-012

scale: 1:500

drawn: J. Bülter

drawing number: 08012.1.LP00/3-1

TECHNICAL DATA OF 1063 kWe BIOGAS PLANT

Description	**UNIT**	**DATA**
Plant Generation Capacity	kW	1063
Plant Load Factor	%	90
Plant Auxiliary Consumption	%	10
Gas Generation Volume	M^3/Day	12500
Silage Silo Capacity	M^3/Day	80
Manure Tank Capacity	M^3/Day	500
De-Oiled Cake Tank Capacity	M^3/Day	30
Mixer Tank Capacity	M^3	8
Digester Diameter	Mtrs	30.4
Digester Height	Mtrs	8.85
Digester Capacity	M^3	6423(appr)
Digester Maximum Slurry Volume	M^3	5697
Digester Slurry Temperature	°C	35-38
Digester gas pressure (pressure side)	bars	0-4 mbar
Digester Gas Pressure (Vacuum side)	bars	
Typical Digester Gas Composition		
Methane Range	Vol %	53 %
Carbon Dioxide-CO_2-Range	Vol %	48 %
Oxygen , O_2	Vol %	<0.5 %
Hydrogen Sulphide, H_2S	Vol %	<600 ppm

GAS ENGINE PARAMETERS:

Sl No	Particulars	Unit	Specification
1	Make		*GE Jenbancher- J 320 C21*
2	Fuel Type		Bio gas
3	Output	kW el	1063
4	Fuel consumption	kcal/hr	527.3
5	Sp fuel consumption	Kcal/kWh	2.38
6	Exhaust gas flow mass (Wet/dry)	Kg/hr	5.64 / 5.22
7	Exhaust gas temp	Deg C	450
8	Heat to jacket water	Kcal/hr	305
9	Heat to intercooler 1st stage & 2^{nd} stage	Kcal/hr	186 & 65
10	Heat to lube oil	Kcal/hr	118
11	Heat to exhaust gas	Kcal/hr	479 (When cooled to 180 deg C)
12	Compression ratio	Ratio	12:1
13	No of Cylinders		20
14	Voltage / Hz		415 / 50

5.4 Biogas Plant Components

The plant comprises 6 main operating units, viz:

Operating unit 1: Biomass Reception / Storage & Substrate / feed Preparation

Operating unit 2: Fermentation and recirculation duct

Operating unit 3: Condensation Circuit

Operating unit 4: Residue storage tank

Operating unit 5: Gas utilization and lubrication oil station

Operating unit 6 : Mechanical BOP / Electrical BOP / Civil

The various operating units are described in the following sections

Operating unit 1: Biomass Reception / Storage & Substrate / Feed Preparation

The materials required for the fermentation process are received in operating stage 1.
The materials that are supplied to the operating stage 1 are

- Cow Dung / Poultry litter
- Silage (Agriculture / Horticulture waste, Forage crops. Etc)
- Grain waste / De -oiled Cake.
- Water (largely recycled)

The portion of each individual component is entered into the feeding program in the panel display. By using the weighing feet of the mixing container, the quantity of each substance which is added to mix can be weighed, controlled and recorded.

Silage: The Agriculture / Horticulture residue and forage crops are fine shredded to produce silage, which is stored in the Silage Vats (Client Scope) which has to be built on site. JCB / Tractor-trolley may be employed to transfer silage from Silage vats to the Biogas Plant in feed section. Silage is filled into the solid material reception (sliding floor / substrate or silo) at the service building and transported by the closed trough screw conveyors.

Cow dung / Poultry litter: The liquid manure from farm is fed from the stables into a lagoon and pumped from the lagoon to the receiving tank with the pump. The storage tank is a round tank that is made of prefabricated elements of reinforced concrete. The agitator system is mounted inside this receiving tank. The agitator ensures that the liquid manure in the receiving tank is of a consistent and homogeneous quality. The tank is covered by a permanent roof made of a fabric-reinforced synthetic material and its walls are 6.00m high. A reception and discharge station for liquid manure is mounted to the receiving tank to be able to feed liquid manure into the mixing tanks.

The liquid manure in the receiving tank is fed into both mixing tanks via the respective Rota Cuts which are installed in the technical building and consists of the flow mill cutters and the biomass inlet pumps. The pumping process stops as soon as the calculated or preset quantity has been transferred.

De-oiled Cake / Grain Waste: The De-oiled cake / grain waste is stored in a silo at the site (Client Scope) and then fed in to the screw conveyors. From there it is transferred to the mixing tank. The filling process stops as soon as the calculated or preset quantity has been transferred.

Recirculated material feed: An appropriate content of dry matter (DM) of max. 15 -18 % of the substrate mix is set in the mixing container. For adjusting the DM-content, slurry suspension can be added to the mixing container from the recirculation duct using the pump. The pumping process stops as soon as the calculated or preset quantity has been transferred.

Water: Water from the available source is added by using the pump for premashing. Adding water can improve mixture pumping performance on the one hand and on the other hand it can be used to regulate the ammonium content and other constituents of the slurry suspension.

Mixer: Mixer Tanks has got capacity of **8 m³** and are designed as **closed stainless steel tanks.** The Substrates are homogenized using the Agitators if desired. The Agitators can be activated optionally via the panel display when the individual ingredients are added. After all the ingredients have been added, the substrate will be homogenized. The agitation time is entered

via the panel display and is adjustable. Pumping process is controlled by the weighing system

Alternatively

Mixing Tanks: The substrates are homogenized by using an agitator. All the substrate pumps are equipped on the pressure side with a pressure monitor that has two switch actuation points. The first switch actuation point switches when the permissible maximum pressure is exceeded. The second switch actuation point switches after a delay when the minimum permissible pressure for a pumping operation is not reached. If one or both of the switch contacts in the pressure monitor are actuated, the pumping operation will be interrupted and an alarm message will be sent via the alarm telephone. If errors occur during the mixing operation, the operation can be completed in manual mode. All the drives can be switched on in manual mode via the panel display.

Operating unit 2: Fermentation

Digester: The Digester has a capacity of 6423 m^3 each and liquid volume of 5697 m^3. Fermentation substrate is fermented within the mesophilic temperature range between 35°C to 38°C. The Digester is a continuously working reactor in which the fermentation substrate is mixed to create a fully homogenous medium. Feeding takes place via a substrate pipe that ends in the Digester above the fluid level. Feeding is a time-controlled process. The through holes in the wall for the substrate pipe are above ground level and with this they are visible at any time.

Based on the amount of substrates (volumes) that have been added, a corresponding volume of fermentation residue is transported to the water recovery unit and solid separation unit. An air hose in the overflow pipe is submerged just below the fluid level in the Digester. This air hose is used to blow air, which is supplied by the compressor, into the overflow pipe at regular intervals in order to help the fermentation residue flow freely through the overflow channel. The Digester is a round reinforced concrete container that is clad with the insulation material and a trapezoidal metal sheet. The finished components of a height of 8.5 m are placed on a binding layer and at the base joint they are fixed by a cast-in-place concrete bed plate or the general procedures followed in that particular regions.

There is a gas chamber above the fluid, which is sealed with a gas barrier film. The gas barrier film which is used, shall meet the requirements in accordance with the Local Regulatory.

The gas density of the film used for the Digester has been tested according to the standard temperature of 23°C and a pressure difference of vacuum to 1 bar.

The Digesters are covered by a gas barrier film, a fabric-reinforced PVC- material coated with Polyester and a weight of about 850 g/m^2, supported by a central column of hardwood. The Inner side of the film is reinforced by polyester tapes that are mounted on the VA-ridge plate in the centre of the roof using fixing plates and bolts. The covering is statically dimensioned considering its own weight, wind and snow load.

There are four agitators in the digester. During fermentation, the agitators are used to mix the substrate around to ensure a consistently homogeneous mixture. The agitators can be repositioned by using the lifting and swiveling devices in order to improve the homogeneous nature of the mixture and prevent the formation of a thick floating layer. The agitators are used only in submerged mode. The Digester includes a heating in order to compensate for heat loss and warm up the substrates after they have been added. The organic substances in the substrates are decomposed as far as possible in the Digester's anaerobic environment. This leads to the formation of biogas, which consists of methane CH_4 and carbon dioxide CO_2.

Desulphurization: The biogas also contains a minor amount of hydrogen sulphide (H_2S), which needs to be removed before the gas is used. For this reason, the gas chamber in the Digester is equipped with a biological desulphurization system. The compressor continuously blows a controlled, small quantity of air into the Digester gas chamber.

The amount of air is regulated in accordance with the hydrogen sulphide content. When the hydrogen sulphide content increases, the air feed increases accordingly; when the hydrogen sulphide content decreases, the air feed also decreases. The oxygen content of the biogas is measured and displayed. The oxygen content should be between a minimum of 0.1% by volume and a maximum of 0.8 % by volume. Under no circumstances the oxygen content may exceed 6 % by volume. Then there will be the risk of explosion. To avoid a back-flow of biogas into the air feed, an inhibitor is fitted to the digesters.

In the biological desulphurization process, bacteria firstly oxidise the hydrogen sulphide into sulphate and then reduce the sulphate to form elementary sulphur. Low oxygen content is generally sufficient for the bacteria (< 1 % by volume).

The bacteria settle on the surfaces of the gas chamber in the digesters. A thin floating layer serves as surface on top of the slurry suspension. The floating layer provides moisture and nourishment for the bacteria. The elementary sulphur deposits on the surfaces in the digesters, particularly on the floating layer, and is recognisable as a yellowish white coating. These deposits of elementary sulphur are successively discharged from the suspension chamber along with the fermentation residue and do not accumulate in the digesters.

High and low pressure safety system: An additional high and low pressure safety system is connected to the gas chamber in the digester. This system ensures that excessively low or high pressures cannot arise in the digester. The high and low pressure safety system consists of a fluid barrier.

When the pressure in the digester changes, the filling levels in the torus and in the blow-off pipe also change.

When the pressure in the digester is zero, both filling levels are the same.
The cross-sectional area ratio of the blow-off pipe and the torus is approx. 1:2.5. This means that the filling level in the torus will alter relatively to the filling level in the blow-off pipe by a ratio of 1:2.5.

If the pressure in the digester increases (e.g. 0 to 3 mbar), the fluid levels in the torus and in the blow-off pipe will also change:

- The fluid in the torus is subjected to greater pressure and drops.
- The fluid level in the blow-off pipe rises.

The height difference in cm between the filling levels in the torus and the blow-off pipe corresponds approximately to the pressure in the digester in mbar (a measurement of 1.5 cm corresponds to 1.5 mbar pressure in the digester, this can be checked against the pressure indication on the pressure monitoring device).

Superfluous fluid in the high and low pressure safety system will be released via the overflow pipe as the pressure increases. The high pressure safety triggers at about 2.5 – 3 mbar (depending on the density of the fluid in the fluid lock)

If under pressure occurs in the digester (e.g. 0 to -1.5 mbar), the fluid levels in the torus and in the blow-off pipe will also change:

- Fluid is drawn into the torus and the level rises.
- The fluid level in the blow-off pipe drops.

The height difference in cm between the filling levels in the torus and the blow-off pipe corresponds approximately to the pressure in the digester in mbar (a measurement of 1.5 cm corresponds to 1.5 mbar under pressure in the digester, this can be checked against the pressure indication on the pressure monitoring device). Superfluous fluid in the high and low pressure safety system will flow back into the digester via the connection pipe as the under pressure increases. The low pressure safety device triggers at about -1.5 mbar (depending on the density of the fluid in the fluid barrier).

Excess pressure: The CHP performance is controlled by the pressure of the gas bubble in the digester. When the pressure increases, the CHP runs up to 100 % output. The feed (substrate feed) to the digester can be adjusted to produce no more than the maximum quantity of biogas that the CHP can process at 100 % output.

The control system (software) ignites the gas flare when the CHP is out of operation or the biogas production exceeds the quantity that the CHP is capable of consuming.

If the pressure in the digester increases further, because the gas flare failed to ignite or the gas production exceeds the consumption of all active consumers, a hardware contact in the control system (set at the gas flare manometer) will attempt to ignite the gas flare a second time and trigger an alarm. The operator is alerted by the alarm telephone and must ensure that the fault is rectified immediately.

If, in spite of these measures, the pressure in the digester continues to rise, the high and low pressure safety system will be activated. The high and low pressure safety system consists of a fluid barrier.

When the high and low pressure safety system triggers due to excessive pressure, the fluid level in the fluid barrier is 2.5 cm. That corresponds to an actuation pressure of about 3 mbar. When the high pressure safety unit triggers, biogas is released from the digester through the fluid lock and allowed to escape into the atmosphere via the blow-off pipe. Dependent on the quantity of gas that is to be released, the pressure in the digester can increase to between 3 and a maximum of 4 mbar.

Low pressure: When the biogas consumption (by the CHP or the gas flare) reduces the pressure of the gas bubble in the digester to the lower limit set in the panel display, the control software will switch off all consumers.

If the pressure drops further, a hardware contact in the control system (setting at the digester manometer) will activate the system's emergency switch-off and trigger an alarm. The operator is alerted by the alarm telephone and must ensure that the fault is rectified immediately.

If, in spite of these measures, the pressure in the digester continues to drop, the high and low pressure safety system will be activated. When the high and low pressure safety system responds due to excessively low pressure, the fluid level in the fluid barrier is 1.5 cm. That corresponds to an actuation pressure of about -1.5 mbar. When the low pressure safety unit triggers, outside air from the atmosphere is drawn through the fluid lock into the digester via the blow-off pipe.

Operating unit 3: Condensate Circuit

Condensate circuit: The biogas from the Digester is warm and damp. In order to use the biogas in the Gas Engine, it must first be cooled and dried as the moisture would damage the combustion engine. The biogas passes to the Gas Engine through underground pipes. Passing the gas through underground pipes reduces the gas temperature and condenses the moisture out of the gas. In order to discharge the generated condensate to the condensate duct, the gas pipes are routed to the duct at a gradient of at least 1 %. The condensate is separated out by the water trap inside the condensate duct. The water trap prevents uncontrolled gas leakage. The submersible pump is installed in the condensate duct. This pump, which is controlled by the fluid level, transfers the condensate to the water recovery unit. The condensate pump may only operate when it is submerged (covered with fluid). The fill level is monitored by the float switch, which triggers an alarm and activates the emergency switch-off when the high and low limits are not kept.

There are three float switches in the condensate duct. These devices are switch at different switch actuation points.

Overfill safety unit, float switch: The filling level may not exceed a defined maximum as this would lead to water ingress into the gas pipe. When the float switch is activated, it triggers an alarm and initiates a complete system emergency-switch off. It also generates an alarm signal via the alarm telephone.

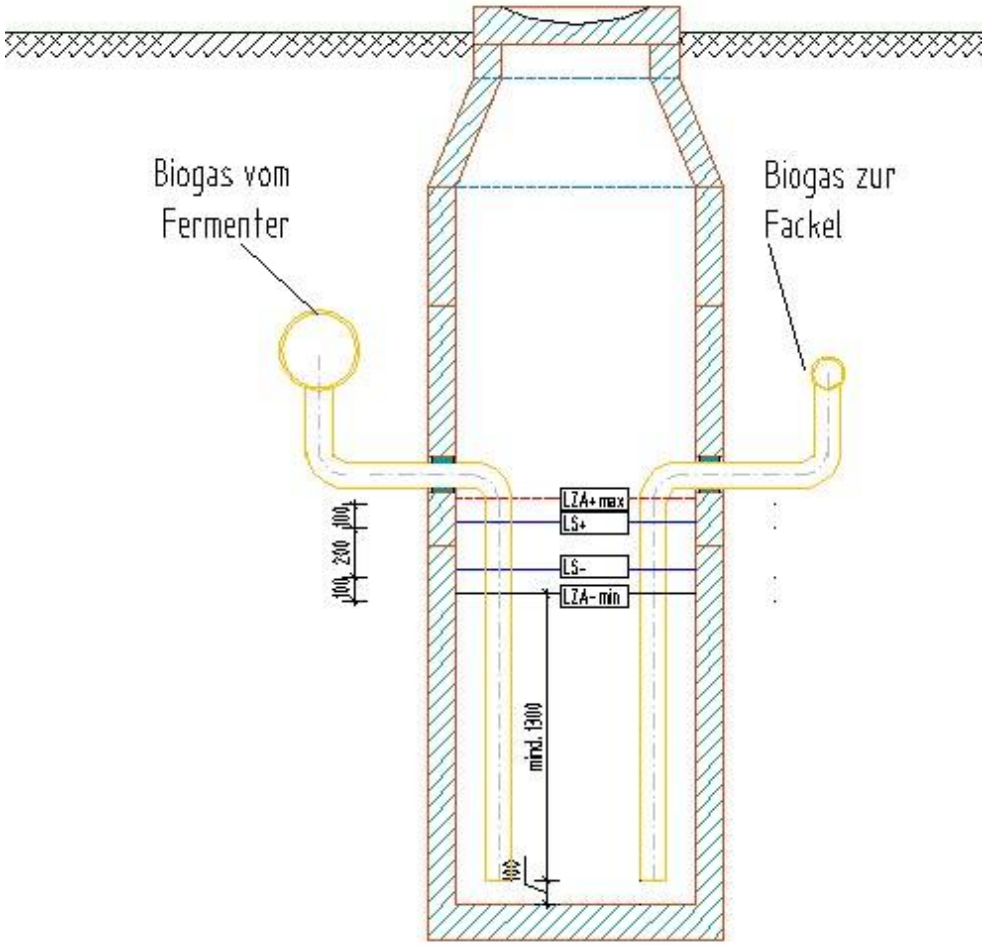
Upper and lower switching-off point, float switch: When the upper switch actuation point is reached, the condensate pump will start up and continue to operate until the lower switch actuation point is reached. It is located above the hydraulic seal.

Minimum filling level safety unit, float switch: The filling level may not fall below a defined minimum as the back pressure of the flu-id in the fluid barrier will drop and it might allow the biogas to escape under the influence of the gas pressure in the Digesters (alarm signal). When the float switch is activated, it initiates a complete system emergency-switch off and triggers an alarm. It also generates an alarm signal via the alarm telephone.

There are three float switches in the respective condensate shafts. These devices all switch at different switch actuation points.

1. Overfill safety unit, float switch: The filling level may not exceed a defined maximum as this would lead to water ingress into the gas pipe. When the float switch is activated, it triggers an alarm and initiates a complete system emergency-switch off. It also generates an alarm signal via the alarm telephone.

2. Upper and lower switching-off point, float switch: When the upper switch actuation point is reached, the condensate pump will start up and continue to operate until the lower switch actuation point is reached. It is located above the hydraulic seal.
3. Minimum filling level safety unit, float switch: The filling level may not fall below a defined minimum as the back pressure of the fluid in the fluid barrier will drop and might allow biogas to escape under the influence of the gas pressure in the digesters (alarm signal). When the float switch is activated, it initiates a complete system emergency-switch off and triggers an alarm. It also generates an alarm signal via the alarm telephone.



Operating unit 4: Fermentation residue buffering a residue storage tank

To store the residue produced by the fermentation process, the residue storage tank, with a filling capacity of 300 m³, is planned in a gas-tight design. The storage unit is a round tank made of PEHD. The finished components are placed on a surface and at the base joint they are fixed by a cast-in-place concrete bed plate. Unlike the digesters, the residue storage tank is not insulated and not heated. Therefore, the fermentation residue is pumped to the Organic fertilizer unit. There it cools down before it is discharged and applied. Furthermore, the residue storage tank is a completely gas-tight PEHD tank. In order to balance pressure, the residue storage tank is connected to the gas chamber in a digester via a gas shuttle tube and a shut-off valve located above the fluid.

Operating unit 5: Gas utilization

The machinery for gas utilization is installed in operating Stage5. For utilizing the gas, a Gas Engine is planned along with a generator – with an electrical power of 1000 kW (combustion power: -0.5 M^3 / kW)

In order to burn the biogas in the Gas Engine, the gas pressure has to be increased with the aid of gas compressor. The output of the gas compressor is regulated. In order to limit noise emissions, the Gas Engine is mounted in a noise-insulated cabin. The biogas is burnt in the gas engine and the resulting energy is converted to electricity by the generator.

The combustion air is drawn in from the outside via the feed air fan. The inlet air generates an overpressure in the noise-insulated cabin of the Gas Engine. The exhaust air flows out via the silencer. In order to limit noise emissions, the Gas Engine is mounted in a noise insulated cabin. The air inlet and outlet channels are equipped with sliding block absorbers for noise reduction. The inlet channel is additionally equipped with a dust filter.

The exhaust gases produced by the combustion process in the Gas Engine are routed through the outer wall into the vertical exhaust gas silencer via an exhaust pipe system. The exhaust gas silencer is designed to be 10.00 m above from the surface ground level or according to the calculation of the chimney height.

The generated thermal energy is used to heat the Digester. Additionally, the available heat from the Gas Engine can be used for other heating purposes. The excess heat is dissipated in the emergency cooler.

In accordance with the safety regulations for agricultural biogas systems, the gas amount that has to be released in case of an emergency must be limited to max. 20m³/h. For this reason, the gas flare is pressure controlled and automatically operated.

Flame traps installed in front of both the Gas Engine and the gas flare which prevent flames backfiring in the pipe system.

Gas Flare system

Emergency flare: The biogas plant is equipped with a permanently installed emergency flare. The gas flare must be placed in a secure distance which is at least 5m from other buildings, 10m from the Digester's and 8 m from the residue containers.

The emergency flare is only used in the event of malfunctions of the intended operation, because for planned stops of the Gas Engine, the generation of gas can be reduced by operational measures (Feeding of the Digester is switched off) and due to the storage function of the gas storage membrane of the Digester's, the gas storage has enough capacity for regular maintenance works. To avoid longer downtimes of the gas engine, the operators of the plant have spare parts in store.

The gas flare is designed for safe and odour-free combustion of excess or unusable biogas from 53 % (CH_4) by volume (e.g. during commissioning). Essentially, the gas flare system is a forced-air fan burner. The burner system includes a type-approved flame trap and gas regulator system complying with required standards.

The gas flare is controlled by the pressure in the gas bubble in the Digester. The gas flare automatically ignites when a given maximum pressure (set in the control system) is reached. The pressure control arrangement and flame monitoring system guarantee safe operation. The flare can be checked automatically and regularly using the control unit.

Lubricating oil station: The CHP needs engine oil as lubricant to work without problems. The lubrication station is placed in the technical room, separated from the CHP. The fresh and the used oil are stored in tanks approved by the building supervisory authorities.

TECHNICAL DESCRIPTION OF JMS 320 GS - BL

Technical Description

Cogeneration Unit

JMS 320 GS-B.L

Biogas Version C21

Electrical output	**1063 kW el.**
Thermal output	**609 kW**

Emission values
NOx < 500 mg/Nm³ (5% O2)

0.01 Technical Data (at module)

Data at:				Full load	Part Load	
Fuel gas LHV		kWh/Nm³		5		
				100%	75%	50%
Energy input		kW	[2]	2.607	2.009	1.410
Gas volume		Nm³/h	*)	521	402	282
Mechanical output		kW	[1]	1.095	821	548
Electrical output		kW el.	[4]	1.063	796	528
Recoverable thermal output						
~ Intercooler 1st stage		kW		186	83	20
~ Lube oil		kW		118	91	79
~ Jacket water		kW		305	293	247
~ Exhaust gas cooled to 450 °C		kW		~	405	303
Total recoverable thermal output		kW	[5]	609	872	649
Total output generated		kW total		1.673	1.668	1.177
Heat to be dissipated						
~ Intercooler 2nd stage		kW		65	44	26
~ Lube oil		kW		~	~	~
~ Surface heat	ca.	kW	[7]	82	60	46
~ Balance heat		kW		50	35	26
Spec. fuel consumption of engine		kWh/kWh	[2]	2,38	2,45	2,57
Lube oil consumption	ca.	kg/h	[3]	0,33	~	~
Electrical efficiency		%		40,8%	39,6%	37,5%
Thermal efficiency		%		23,4%	43,4%	46,0%
Total efficiency		%	[6]	64,2%	83,0%	83,5%
Hot water circuit:						
Forward temperature		°C		80,0	84,3	80,7
Return temperature		°C		70,0	70,0	70,0
Hot water flow rate		m³/h		52,3	52,3	52,3

*) approximate value for pipework dimensioning
[_] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance, and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...).

Main dimensions and weights (at module)

Length	mm	~ 5.700
Width	mm	~ 1.900
Height	mm	~ 2.300
Weight empty	kg	~ 11.000
Weight filled	kg	~ 11.500

Connections

Hot water inlet and outlet	DN/PN	80/10
Exhaust gas outlet	DN/PN	250/10
Fuel gas (at gas train)	DN/PN	100/16
Fuel Gas (at module)	DN/PN	100/10
Water drain ISO 228	G	½''
Condensate drain	DN/PN	50/10
Safety valve - jacket water ISO 228	DN/PN	2x1½''/2,5
Safety valve - hot water	DN/PN	65/16
Lube oil replenishing (pipe)	mm	28
Lube oil drain (pipe)	mm	28
Jacket water - filling (flex pipe)	mm	13
Intercooler water-Inlet/Outlet 1st stage	DN/PN	80/10
Intercooler water-Inlet/Outlet 2nd stage	DN/PN	65/10

0.02 Technical data of engine

Manufacturer		GE Jenbacher
Engine type		J 320 GS-C21
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		20
Bore	mm	135
Stroke	mm	170
Piston displacement	lit	48,67
Nominal speed	rpm	1.500
Mean piston speed	m/s	8,50
Filling capacity lube oil	lit	370
Filling capacity water	lit	150
Length	mm	3.320
Width	mm	1.358
Height	mm	2.065
Weight dry	kg	5.000
Weight filled	kg	5.500
Moment of inertia	kgm²	8,61
Direction of rotation (from flywheel view)		left
Flywheel connection		SAE 18"
Radio interference level to VDE 0875		N
Starter motor output	kW	9
Starter motor voltage	V	24

Thermal energy balance

Energy input	kW	2.607
Intercooler	kW	251
Lube oil	kW	118
Jacket water	kW	305
Exhaust gas total	kW	740
Exhaust gas cooled to 180 °C	kW	479
Exhaust gas cooled to 100 °C	kW	615
Surface heat	kW	50
Balance heat	kW	50

Exhaust gas data

Exhaust gas temperature at full load	°C [8]	450
Exhaust gas mass flow rate, wet	kg/h	5.645
Exhaust gas mass flow rate, dry	kg/h	5.223
Exhaust gas volume, wet	Nm³/h	4.389
Exhaust gas volume, dry	Nm³/h	3.884
Max.admissible exhaust back pressure after engine	mbar	60

Combustion air data

Combustion air mass flow rate	kg/h	5.179
Combustion air volume	Nm³/h	4.006
Max. admissible pressure drop in front of intake-air filter	mbar	10

basis for exhaust gas data: natural gas: 100% CH4; biogas 65% CH4, 35% CO2

Output / fuel consumption

ISO standard fuel stop power ICFN	kW	1.095
Mean effe. press. at stand. power and nom. speed	bar	18,00
Fuel gas type		Biogas
Based on methane number	MZ d)	100
Compression ratio	Epsilon	12,50
Min./Max. fuel gas pressure at inlet to gas train	mbar	150 - 200 c)
Allowed Fluctuation of fuel gas pressure	%	± 10
Max. rate of gas pressure fluctuation	mbar/sec	10
Maximum Intercooler 2nd stage inlet water temperature	°C	50
Spec. fuel consumption of engine	kWh/kWh	2,38
Specific lube oil consumption	g/kWh	0,30
Max. Oil temperature	°C	90
Jacket-water temperature max.	°C	95

c) Lower gas pressures upon inquiry
d) based on methane number calculation software AVL 3.1

Sound pressure level

Aggregate b)	dB(A) re 20µPa	95
31,5 Hz	dB	78
63 Hz	dB	90
125 Hz	dB	92
250 Hz	dB	89
500 Hz	dB	92
1000 Hz	dB	90
2000 Hz	dB	89
4000 Hz	dB	87
8000 Hz	dB	90
Exhaust gas a)	dB(A) re 20µPa	121
31,5 Hz	dB	97
63 Hz	dB	108
125 Hz	dB	118
250 Hz	dB	110
500 Hz	dB	113
1000 Hz	dB	114
2000 Hz	dB	117
4000 Hz	dB	115
8000 Hz	dB	114

Sound power level

Aggregate	dB(A) re 1pW	117
Measurement surface	m²	109
Exhaust gas	dB(A) re 1pW	129
Measurement surface	m²	6,28

a) average sound pressure level on measurement surface in a distance of 1m according to DIN 45635, precision class 2.
b) average sound pressure level on measurement surface in a distance of 1m (converted to free field) according to DIN 45635, precision class 3.
Operation with 1200 rpm see upper values, operation with 1800 rpm add 3 dB to upper values.
Engine tolerance ± 3 dB

0.03 Technical data of generator

Manufacturer		STAMFORD
Type		PE 734 C2
Type rating	kVA	1.550
Driving power	kW	1.095
Ratings at p.f. = 1,0	kW	1.063
Ratings at p.f. = 0,8	kW	1.052
Rated output at p.f. = 0,8	kVA	1.315
Rated current at p.f. = 0,8	A	1.830
Frequency	Hz	50
Voltage	V	415
Speed	rpm	1.500
Permissible overspeed	rpm	2.250
Power factor lagging		0,8 - 1,0
Efficiency at p.f. = 1,0	%	97,1%
Efficiency at p.f. = 0,8	%	96,1%
Moment of inertia	kgm^2	36,33
Mass	kg	2.967
Radio interference level to VDE 0875		N
Construction		B3/B14
Protection Class		IP 23
Insulation class		H
Temperature (rise at driving power)		F
Maximum ambient temperature	°C	40
Total harmonic distortion	%	1,5

Reactance and time constants

xd direct axis synchronous reactance	p.u.	2,33
xd' direct axis transient reactance	p.u.	0,14
xd'' direct axis sub transient reactance	p.u.	0,10
Td'' sub transient reactance time constant	ms	10
Ta Time constant direct-current	ms	20
Tdo' open circuit field time constant	s	2,23

0.04 Technical data of heat recovery

General data - Hot water circuit

Total recoverable thermal output	kW	609
Return temperature	°C	70,0
Forward temperature	°C	80,0
Hot water flow rate	m³/h	52,3
Nominal pressure of hot water	bar	10
Pressure drop hot water circuit	bar	0,80
Maximum Variation in return temperature	°C	+0/-20
Max. rate of return temperature fluctuation	°C/min	10

Mixture Intercooler (1st stage)

Type		gilled pipes
Nominal pressure of hot water	bar	10
Pressure drop hot water circuit	bar	0,20
Hot water connection	DN/PN	80/10

Mixture Intercooler (2nd stage) (Intercooler separate)

Type		gilled pipes
Nominal pressure of hot water	bar	10
Pressure drop hot water circuit	bar	0,20
Hot water connection	DN/PN	65/10

Heat exchanger lube oil

Type		shell-and-tube
Nominal pressure of hot water	bar	10
Pressure drop hot water circuit	bar	0,20
Hot water connection	DN/PN	80/10

Heat exchanger engine jacket water

Type		plate heat exchanger
Nominal pressure of hot water	bar	10
Pressure drop hot water circuit	bar	0,20
Hot water connection	DN/PN	80/10

Exhaust gas heat exchanger

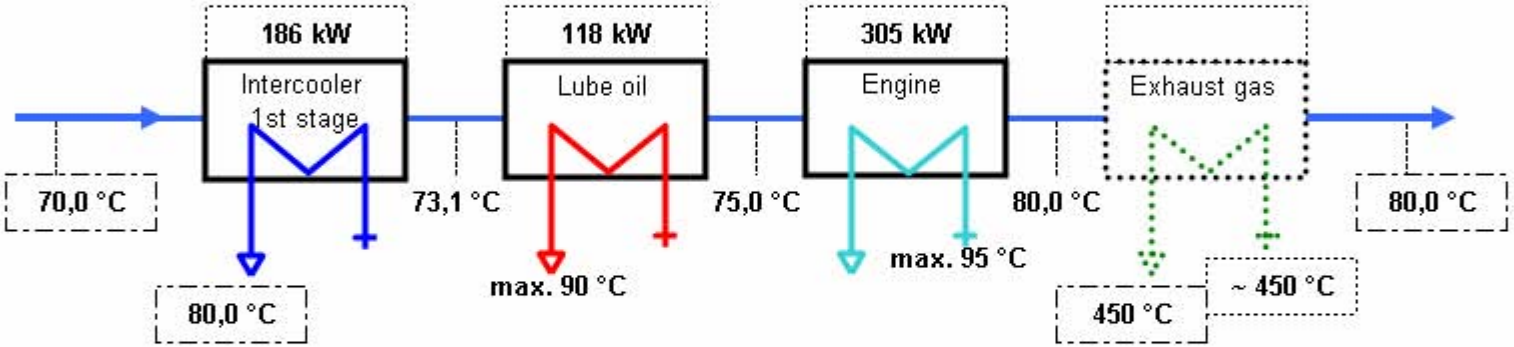
Type		shell-and-tube
PRIMARY:		
Exhaust gas pressure drop approx	bar	0,02
Exhaust gas connection	DN/PN	250/10
SECONDARY:		
Nominal pressure of hot water	bar	6
Pressure drop hot water circuit	bar	0,20
Hot water connection	DN/PN	100/10

Hot water circuit

Biogas JMS 320 Version C21 **J 320 GS-C21**

Recoverable thermal output = 609 kW (+/- 8%)

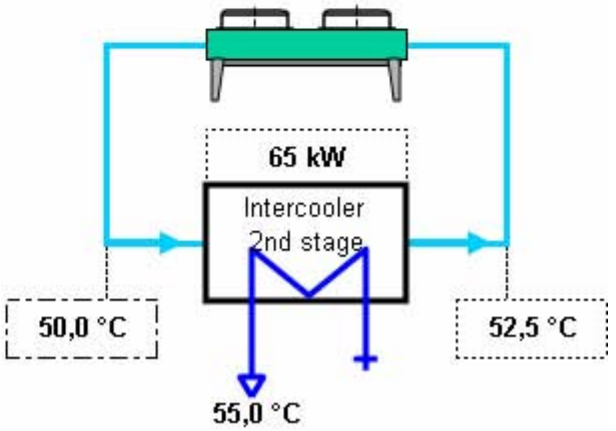
Hot water flow rate = 52,3 m³/h



Low temperature circuit (calculated with Glykol 37%)

Heat to be dissipated = 65 kW (+/- 8%)

Cooling water flow rate = 25,0 m³/h



Operating unit 6: Mechanical BOP / Electrical BOP / Civil

MECHANICAL BALANCE OF PLANT

Raw water supply system: Raw water is required per day for 1 x 1063 KWe Biomethanation plant. Suitable raw water pumping station and storage provisions for 500 KL is made.

Fire Protection system: For the Plant building, Engine room, Sub station and Control rooms suitable portable fire extinguishers will be provided as per norms. For the out door areas like Feed stock silage, Digesters etc., Fire hydrants as per norms will be provided.

Design Basis: The following sections describe briefly the design basis adopted for the various Mechanical equipments of the Project.

The design, manufacture, inspection, testing and installation of all equipment and systems covered herein shall conform to the latest editions of Indian and International codes and standards. Best engineering practices shall be followed wherever the relevant standards are not available.

Water System: Water system consists of raw water supply system.

- Raw water / fire water storage reservoir is planned to be provided considering two (2) weeks' make up water requirement. The raw water reservoir shall be above ground structure of RCC construction with central partition.
- 2 x 100% raw water supply pumps of horizontal centrifugal construction will meet the Plant make up water requirement.
- The fire water system will be designed as per statutory requirements. It is proposed to install one (1) no. diesel drive hydrant pump, with one motor driven pump of identical capacity as standby. 1 x 100% Jockey pump will be considered for pressurization of the hydrant network.
- The raw water and fire water pumps will be housed in common pump house. Suitable handling arrangement will be provided for handling of equipment for erection / maintenance.

Fire Protection System

- Fire protection system generally shall be designed based on Loss Prevention Association (LPA) guidelines and NFPA standards.
- The fire protection system shall be designed on the following basis:
- Control and extinguishing of only one fire at a time occurring through the whole Power plant area.
- Fire spreading is assumed not to exceed the fire area limits it arises from.
- Design water demand shall generally not exceed the greatest amount of water required for each fire scenario.
- For the purpose of system design, the entire Power Plant is considered as ORDINARY HAZARD risk as per the classification of TAC.
- The various types of fire prevention/protection systems considered for fighting the fires in different plant areas/buildings are :
- Fire Hydrant System
- Fire detection
- Portable Fire Extinguishers
- Fire detection and alarm system.

Ventilation and or Air Conditioning System: Ventilation and or air conditioning facilities shall be provided for the various plant premises to ensure proper working environment both for men and machines and to maintain necessary environmental conditions for proper storage of plant & machinery, equipment and materials in the following areas.

• Power house and Plant buildings.
• Switch gear and cable cellar room.
• Raw water, Fire water pump house MCC room.
• All toilets / store room etc.

Wet Ventilation System:

- Wet ventilation system consisting of air washer unit in masonry construction with adequate capacity centrifugal fan including dry metallic filters, auto viscous air filters, water spray bank, circulating spray water pump, spray water basin, supply air ducting etc. shall serve the following areas in Power–house building.
- Cable spreader room
- Switchgear room
- Engine - Alternator Hall
- General Exhaust Ventilation
- General Exhaust Ventilation with wall mounted axial flow fans is considered for toilets and other miscellaneous areas.

Air conditioning system

- Air conditioning system facilities shall be provided for the various areas to ensure proper functioning of equipment and for human comfort. For critical areas like all control rooms, Chemical test lab, Instrument lab etc. air conditioning system shall be designed for continuous duty and office room/ conference room shall be designed for intermittent duty.
- Air conditioning is proposed to be provided for the following areas in Power House building and other areas in the plant.
- Control room area
- UPS room
- Office area

ELECTRICAL BALANCE OF PLANT AND EVACUATION SYSTEM

- For Start up power and other Power requirements a suitable substation will be provided. A suitable transmission line will be provided for the incoming power into the substation from the grid. A suitable distribution system with step down Transformers for supply of power to the various auxiliaries at 415 V and 220 V will be installed.

- Power is generated at 415 V. This is transmitted through a Switch gear and power cables to a step up Transformer (415V / 22 KV). The substation described above will be suitably equipped to receive power. The 22 KV transmission line will be used for evacuation of Power to the nearest receiving station of the State grid.

General Principles of Equipment Design

- The design of the electrical system will be based on the requirements for the safe & reliable performance of the captive power plant and the interconnected electrical system and to ensure safety and convenience in operation. 100% redundancy will be provided in auxiliary power supply feeders to 415V PCC of the Power Plant to ensure the reliable power supply even during cable failure and transformer outages.
- All items of electrical equipment will be suitable for operation plant environment. The Design ambient temperature for all electrical equipment shall be 50° C.
- All items of electrical equipment will be suitable for continuous and short time duty in the environmental conditions prevailing at site without exceeding temperature rise values stipulated in relevant IS standards.
- The design, manufacture, inspection, testing and installation of all equipment and systems covered herein shall conform to the latest editions of Indian and International codes and standards. Best engineering practices shall be followed wherever the relevant standards are not available.

System Details

The system details at various utilization equipment voltages will be as given below:-

Service	**Voltage**	**Phase**	**Frequency**	**System Neutral Earthing**
Generation voltage	415kV AC	3 Ph	50 Hz	Resistance earthed
415V System	415V AC	3 Ph	N 50 Hz	Solidly earthed
LV 3 Phase Motors (up to 160kW)	415V AC,	3PH	50 Hz	Solidly earthed
Lighting	240V AC	1PH	N 50 Hz	Solidly earthed
Space heater	240V AC,	1PH	N 50 Hz	Solidly earthed
Instrumentation & Control U.P.S AC output	110V AC	1PH	N 50 Hz	Solidly earthed
Instrumentation & Control DC Battery	110V DC	(2 wires)		Unearthed
Protection Switchgear Control	110V DC	(2 wires)		Unearthed

- In line with standard practice and safety requirements in terms of fast sensitive protection and reduction of LV system over voltages from personnel safety considerations, the 415V system neutral will be solidly earthed.
- The salient design features of the main electrical equipments are described below:-

HT / LT Auxiliary Transformers

Generator Transformer

- 415 V / 11 KV Generator transformers will feed power from the individual units to the sub station.
- The above transformers will be oil filled outdoor type with ONAN cooling and will be provided with a tap changer on the HV winding with range of ±10% in steps of 1.25%.
- The LV neutral will be resistance earthed.

Switchgear, Power / Motor Control Centres and Distribution Boards

- 415 V system will consist of the following:
- One (1) no. indoor 415 V metal clad, compartmentalized, modular, free standing, draw out type Plant Switchgear (415 V PCC) for complete Plant Aux. System.
- 415 V indoor, metal clad, compartmentalized, modular, free standing draw out type Motor Control Centers (MCCs) will be provided for various plant auxiliaries like Raw water, fire water, A/C & Ventilation System and other balance of plant equipments.
- For 415 V PCC, adequate interlocking will be provided in the operation of incoming and bus coupler circuit breakers to prevent parallel operation of two transformers. This interlocking is envisaged in order to prevent the fault level exceeding the rated short circuit level of the switchgears. In case of failure of any one transformer, the other transformer will automatically take over the load connected to that transformer by auto closing of the relevant bus coupler breaker. At any time, two incomers will be in close position and bus couplers will be in open position. Auto changeover will be blocked in case the transformer LT incomer breaker trips due to the action of over current / Earth fault relay.
- The bus bars will be aluminum alloy and will be designed to withstand without damage, a fault current of 50 kA RMS at 415V for one (1) second.
- The 415V breakers will be of air-break, trip-free and draw-out type. The operating mechanism will be spring charged, stored energy type. The breaker rupturing capacity shall be 50 kA at 415V.
- MCCB will be triple pole.
- A.C distribution (ACDB) will receive power from 415V switchgears and cater to the A.C auxiliary supply requirements of the plant.
- Lighting Distribution Board (LDB) will receive power from 415V switchgears and supply to lighting and receptacle panels in the plant.

Protection of Major Equipment

- The total protection system can be classified broadly as:
- Protection of power plant auxiliary equipment.
- All relays will be static or numerical type with multiple current / voltage and time characteristics with widely adjustable settings.

Generator Transformer

- Over current protection (IDMTL and instantaneous).
- Buchholz protection.
- LV restricted earth fault protection.

- Oil/winding temp alarm/trip protection.

Motors

- All LT motors will be protected from overloads by thermal overload relays and short circuit by fuses.

Instrument Transformers

- All the current and voltage transformers required for protection system will have adequate VA burden, knee point voltage, instrument safety factor and other characteristics suitable for the application.
- For instrument transformers, accuracy class will be as follows:

Metering Scheme

Generator will be provided with the following minimum metering.
3-Phase current, 3-phase voltage, Power factor meter, Active power meter, Reactive power meter, Active energy meter, Reactive energy meter, Active & Reactive energy Recorder, Frequency meter.

DG metering and synchronizing requirements:

- Active power meter
- Power factor meter
- Ammeter with selector switch
- Active energy meter
- Voltmeter with selector switch
- Frequency meter
- Hour-run meter
- Synchronizing facility with cut-off switch
- Auto-synchronizing feature.

Power and Control Cables

11 kV Power Cables: 11kV cables will be of stranded aluminum conductor, heavy duty, XLPE insulated, each core screened on conductor as well as on insulation, Colour coded, extruded PVC inner sheathed, single round galvanized steel wire armored (for multicore cables only) and overall PVC sheathed. 11kV cables will be suitable for unearthed system, as the existing electrical system is resistance earthed.

LT power cables: LT power cables will be 1100V grade with stranded Aluminum conductor, XLPE insulated, extruded PVC inner sheathed, single round galvanized steel wire armored (for multicore cables only) and overall PVC sheathed.

Control cables: Control cables shall be multicore 1100V grade, 2.5 Sq mm stranded copper conductors, PVC insulated, PVC inner sheathed, round steel wire armored and overall PVC sheathed. Power to motors up to 5.5 kW will be fed through 3 core, 2.5 Sq mm copper cable for ease of termination at small motor terminal box.

Lighting and System

- Lighting panels / receptacle panels with miniature circuit breakers will be provided for various areas to cater to the lighting and power receptacle requirements of the POWER PLANT. The emergency lights will be provided at strategic points in the plant such as control room, staircase, near exits / entrances etc.

- For general illumination fluorescent fixtures will be used. High bay / medium bay areas in the plant will be illuminated by sodium vapor lamps.

- The following Lux level shall be considered area-wise:

Control room	: 500 Lux
Switchgear / MCC room	: 300 Lux
Transformer Area	: 30 Lux
Outdoor Areas	: 30 Lux
Street lighting	: 10 Lux
Pump Houses	: 150 Lux
Switchyard Area	: 30 Lux
Battery Room	: 200 Lux

Safety Earthing & Lightning Protection

- A safety earthing system comprising of buried mild steel conductor earthing grid will be provided for the Plant buildings, switchyard and other outlying areas. This will be connected to the earth grids in various buildings. The buried earthing grid will be further connected to earthing electrodes buried in ground and located at representative points. All exposed earthing conductors will be of galvanized steel.

- Lightning protection system comprising of roof conductors, air terminals and down comers will be provided for all structures and buildings and will be of galvanized steel.

Station DC System

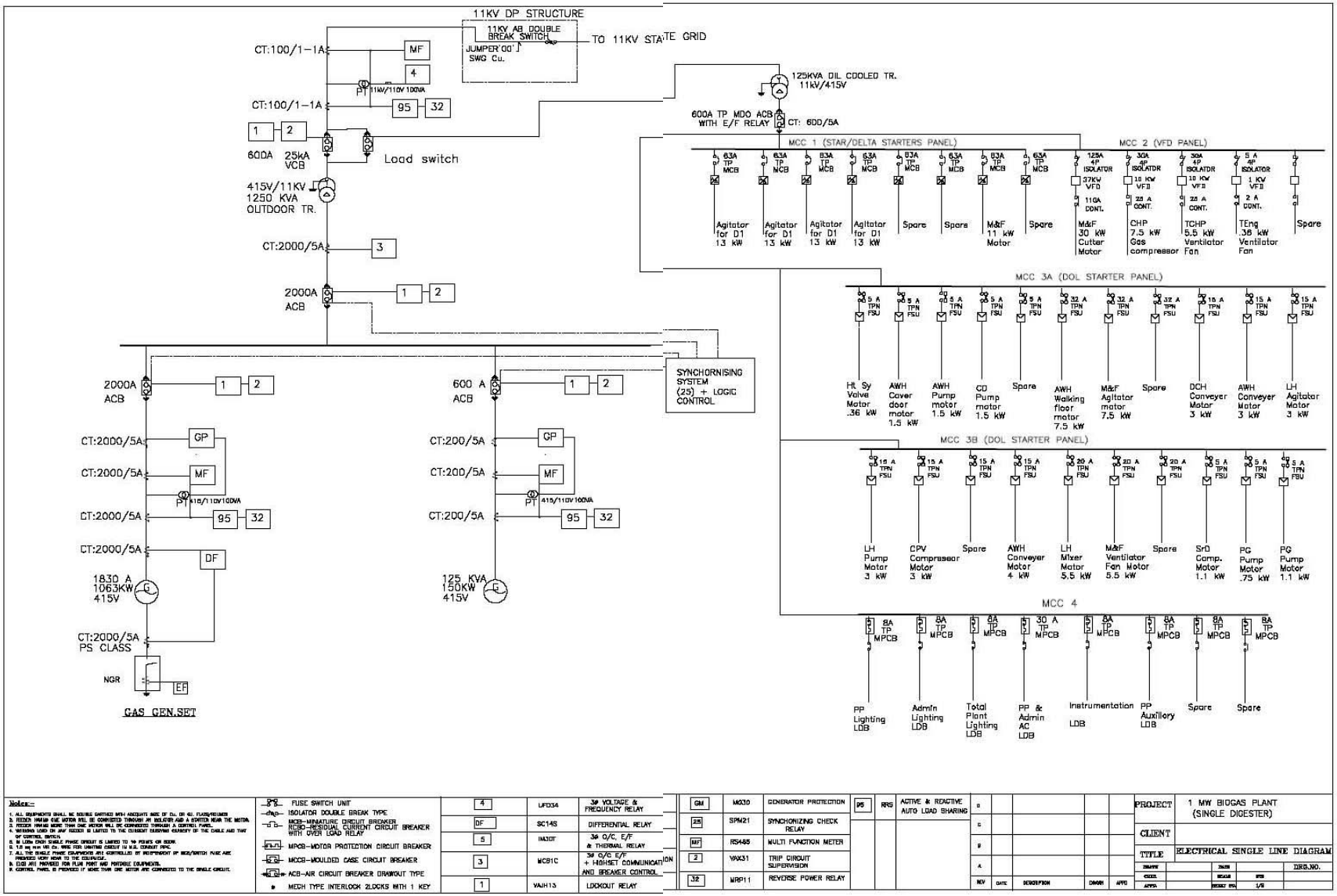
- 110V power supply shall be provided for control, protection, indication etc.
- 110V DC system shall comprise of one (1) no. lead acid battery complete with float charger and float-cum-boost charger

Uninterrupted Power Supply (UPS) System: One battery charger with associated float and boost chargers and inverters would be provided to derive uninterrupted 110V AC power supply through suitably rated inverters. The batteries will be sized to cater to the loads for 1 hour. This power supply will be used to feed essential services such as control, instrumentation, annunciation, etc.

Plant Communication System: A centralized electronic exchange is proposed, to facilitate intercommunication in the Power Plant for operation / administrative purpose. All plant areas, administrative areas will have telephones connected to
the Plant Exchange.

Fire Alarm System: A Fire Alarm System consisting of manual call points and smoke / flame detectors or rate of rise of temperature detectors will be provided in the plant building, switchgear room, control room & cable galleries.

Single line diagram of power evacuation and auxiliary load



Notes:—

1. ALL EQUIPMENTS SHALL BE DOUBLE EARTHED WITH ADEQUATE SIZE OF Cu. OR GI. FLATS/WIRES.
2. FEEDER HAVING ONE MOTOR WILL BE CONNECTED THROUGH AN ISOLATOR AND A STARTER NEAR THE MOTOR.
3. FEEDER HAVING MORE THAN ONE MOTOR WILL BE CONNECTED THROUGH A CONTROL PANEL.
4. MAXIMUM LOAD OR ANY FEEDER IS LIMITED TO THE CURRENT CARRYING CAPACITY OF THE CABLE AND THAT OF CONTROL SWITCH.
5. M LOW SPEED SINGLE PHASE CIRCUIT IS LIMITED TO NO POINTS OR SOCKS.
6. 1.0 sq mm MIN Cu. WIRE FOR LIGHTING CIRCUIT IS 6.0. CURRENT RATING.
7. ALL THE SINGLE PHASE EQUIPMENTS ARE CONTROLLED BY INDEPENDENT DP MCB/SWITCH FUSE ARE PROVIDED VERY NEAR TO THE EQUIPMENT.
8. DUAL ARE PROVIDED FOR PLUG POINT AND PORTABLE EQUIPMENTS.
9. CONTROL PANEL IS PROVIDED IF MORE THAN ONE MOTOR ARE CONNECTED TO THE SINGLE CIRCUIT.

FUSE	FUSE SWITCH UNIT
ISOLATOR	ISOLATOR DOUBLE BREAK TYPE
MCB	MCB—MINIATURE CIRCUIT BREAKER RCBO—RESIDUAL CURRENT CIRCUIT BREAKER WITH OVER LOAD RELAY
MPCB	MPCB—MOTOR PROTECTION CIRCUIT BREAKER
MCCB	MCCB—MOULDED CASE CIRCUIT BREAKER
ACB	ACB—AIR CIRCUIT BREAKER DRAWOUT TYPE
#	MECH TYPE INTERLOCK 2LOCKS WITH 1 KEY

4	UFD34	3Φ VOLTAGE & FREQUENCY RELAY	
DF	SC14S	DIFFERENTIAL RELAY	
5	IMA1DT	3Φ O/C, E/F & THERMAL RELAY	
3	MCB1C	3Φ O/C E/F + MBHSET COMMUNICATION AND BREAKER CONTROL	
1	VAJH13	LOCKOUT RELAY	

GM	M330	GENERATOR PROTECTION	95	RRS	ACTIVE & REACTIVE AUTO LOAD SHARING
25	SPM21	SYNCHONIZING CHECK RELAY			
MF	RS485	MULTI FUNCTION METER			
2	YAX31	TRIP CIRCUIT SUPERVISION			
32	WRP11	REVERSE POWER RELAY			

REV	DATE	DESCRIPTION	DRAWN	APPD
D				
C				
B				
A				

PROJECT	1 MW BIOGAS PLANT (SINGLE DIGESTER)
CLIENT	
TITLE	ELECTRICAL SINGLE LINE DIAGRAM
DRAWN	DATE
CHKD.	SCALE NTS
APPD.	DRG.NO.

Electrical system / control unit

The operating unit 6 consists of the electrical system and the control unit of the biogas plant. In the switch room, there are the switching cabinet and the PC with display for the biogas plant.

The display is used to select the operating modes (manually or automatically) and to display the operating states, to display data and to generate reports.

The switching cabinet is fitted with an isolator switch and a system emergency switch-off. Key switches for the drives of the main components are provided so that each drive can be switched off or enabled.

The alarm selection unit has a buffer battery and in the event of emergency alarms, it sends independent alarms by telephone to at least two responsible people with different telephone numbers. Additionally, the malfunction is annunciated by acoustic signal. Malfunctions of the four gas sensors are additionally signaled by an acoustic signal, as well as an optical signal in the relevant areas and outside the technical building.

The switching cabinet is equipped with the fan as well as a fire warning device.

BUILDINGS, CIVIL AND STRUCTURAL WORKS.

Codes and Standards: The Indian Codes and Standards as applicable will be generally used for design of civil and structural works.

General Design Specification

Concrete Structures

- The following grades of concrete as per IS:456 will be adopted for the type of structures noted against each. Design mix shall be used for RCC work as per standards.

  M15 - Grade slab, paving, drain etc.

  M20 - Lightly loaded structures.

  M25 - For all structural elements unless noted otherwise.

  M25 - For STG foundation, tank foundations and water retaining structures.

  M25 - Precast units.

  1:3:6 - Plain Concrete below tank foundations and water retaining structures.

  1:4:8 - Plain Concrete below Footings, grade slab and base slab of drains.

  1:5:10 - Fill concrete.

- All structural concrete will be made dense and nonporous with water cement ratio not exceeding 0.45. Plasticizers will be used, if required, to maintain the required slump. For structural concrete items, Ordinary portland cement (33/43/53 Grade) conforming to IS:8112 will be used. High yield strength deformed bars conforming to IS 1786 will be used for reinforcement.

- Design of structural concrete for liquid retaining structures and dry basements for which external water proofing is not provided, will be designed in accordance with the recommendations of BS:8007. Crack width will be restricted to 0.1 mm. Minimum thickness of structural elements for water retaining structures with two layers of reinforcement will be 200 mm.
- Design of RCC structures will be by limit state method as per IS: 456. Foundation will be sized for working loads and designed by limit state method considering appropriate partial safety factors as per IS: 456.

Steel Structures: Design of steel structures will be carried out by working stress method as per IS:800. Generally all shop and field connections will be welded, except for field connections of bracings and other minor members, which can be bolted type. Structures will be generally designed as rigid frames in the transverse direction and as braced frame in the longitudinal

direction. All moment connections, if bolted will be of High strength friction grip bolts. Shear and other minor connections, if bolted may be made with mild Steel / High strength bearing bolts.

Foundation for Underground Structures

- The foundation type and depth will be decided based on the soil investigation parameters.

- Settlement criteria for shallow foundations will be generally as follows (subject to specific requirement & differential settlement):

  - 25 mm for plant buildings and structures.
  - 40 mm for non-plant buildings and structures.
  - 80 mm for steel storage tank foundations.

- For design of walls of basement, trenches, channels etc. below ground, lateral pressure due to a vertical surcharge of 10 KN/m² will be considered in addition to earth and ground water pressure etc. In case of heavy wheel loads, lateral surcharge due to actual wheel loads will be substituted. When a portion or whole of the adjacent soil is below free water surface, computations will be based on submerged weight of soil plus full hydrostatic pressure.
- 75 mm thick lean concrete 1:4:8 will be provided below footings, base slab and water retaining structures as mudmat.
- The following factors of safety will be considered for stability of foundation and underground structures (Ref. IS: 456 & IS: 3370)

Stability against overturning and sliding	-	1.5
Stability against uplift	-	1.2

Building Foundation: Type of foundation system, i.e. piled foundation, isolated footing or raft foundation will be decided based on the loads, soil conditions and as per recommendation of detailed geo-technical reports.

Foundations for Vibratory Equipment: All machine foundations will be designed in accordance with the provisions of the latest edition of national standards, international standards and manufacturer's standards.

SPECIFIC TECHNICAL REQUIREMENTS AND FUNCTIONAL REQUIREMENTS

Site Grading & Excavation

Site Grading: Site grading will have to be fixed with due reference to site drainage and other system requirement.

Roads, Drainage, Sewerage

Roads: Plant service roads will be 6.0 m (for double lane) wide RCC roads with 1 m wide shoulders on either side of the road. Single lane roads shall be with 3.75 m wide. Roads and other allied structures will be designed for class ”A” loading in accordance with relevant IS / IRC codes. Road widths, curves and parking areas will have adequate space for manoeuvring the vehicles. Road width and turning radius will be adequate for transporting equipment to the site of erection.

Paving: Higher thickness as per design will be provided in areas of vehicular movement. Transformer and Switchyard area will be covered with gravel.

Drainage: The plant storm water drainage shall take into account the topography of the plant area, drainage pattern, intensity of rainfall etc. Storm water shall be collected from roads, hard standing and impervious areas and discharged into the external drainage system.

The drains will generally be of open type. Drainage of rainwater will be by gravity. All open drains and drops / falls will be in brick masonry or with locally available dressed stone masonry.

Sewage System: Sewage from the buildings shall be collected in suitably located septic tank for treatment before disposal. The effluent from the septic tank shall be disposed into a storm water drain within the boundary limit. Suitable manholes will be provided in brickwork at every 30m intervals as well as at junctions within the battery limit.

ARCHITECTURAL AND FINISHING WORKS

Floor Finishes:

Ground Floor (of all plant buildings), Switchgear rooms, Operating floors etc.	-	Indian Patent stone with metallic hardener.
Operating floor for Power house	-	Indian Patent stone with metallic hardener
Control room	-	False floor and PVC tile flooring on false floor panels.
Battery room	-	Acid Resistant flooring and dado (2.0 metres)
Offices	-	Pre-cast terrazzo tiles
Toilet	-	Ceramic Tiles (‘Nitco’ or equivalent)
Oil, acid & alkali spillage areas	-	Epoxy coating.

False Ceiling

Control room	-	LUXALON or equivalent
Office areas	-	Particle board

Roof finishes

Plant buildings	-	Bituminous felt based water proofing treatment.

Joinery

i) **Windows**

Turbine bay	-	Glazed, openable Windows / Ventilators with steel frame
Control room	-	Glazed, fixed windows / Ventilators with aluminium frame
Switchgear room	-	Glazed, fixed windows / ventilators with steel frame
Offices	-	Glazed, openable windows / ventilations with steel frame.

ii) **Doors**

Control room	-	Glazed doors with aluminium frame.
Offices	-	Glazed doors with steel frame.
Toilets	-	M.S. / PVC doors.
All other doors	-	Double plated steel doors
Fire barrier doors	-	Specially designed steel doors with 2 hours fire rating.

iii) **Painting**

Structural steel	-	Protective coating after sand blasting, as per specification .
Metal Joinery	-	Synthetic enamel paint
All Ceilings	-	Oil bound distemper (office & control room) White washing (all other areas)
Internal wall surfaces	-	Oil bound distemper for office & control room & white washing in other areas.
External faces of walls	-	Cement based water proof paint
Walls of battery room & other	-	Acid resistant paint. Acid / alkali spillage areas

- A standard colour scheme for different buildings/structures will be prepared and the approval of the owner obtained, before commencement of work.

6.0 ORGANIC FERTILISER UNIT

6.1 Organic Fertilizer Unit Description

For each Digester the effluent would be of the order of 135 kL /day with 5.5 - 7% TS. The Digester Effluent has wide ranging use as organic manure including for grains/ sugar cane farming… but have preferential applications for, short cycle, forage/energy crops & horticulture products farming.

The effluent from the Biogas Digester is sent to the organic fertilizer unit where the solids & the liquid are separated. The separated solids can be used as organic fertilizer by further processing such as composting adding up other available materials. Advantages of using digester effluent as fertilizer are:

a. General Positive impacts on environment:

- Decrease of odor of manure
- Less CH_4 emissions
- Reduce ground water contamination

b. Close nutrient cycle with using biogas plant effluent as fertilizer:

- Nutrients in feedstock of biogas plants can be reused after anaerobic digestion.
- Only few losses of nutrients during storage, transport and biogas process.

C. Improvements on manure quality with anaerobic digestion:

- Degradation of cells, organic acids and long chain organic matter
- Increase of availability of nutrients (especially nitrogen)
- Increase of humus on the fields (compared to combustion)

The Liquid Organic Fertilizer Potential as per Envitec Biogas AG, Germany is as below

LIQUID ORGANIC FERTILISER POTENTIAL (OTTO CYCLE)

Wir geben Bio Gas. EnviTec Biogas.

Project A	Co-substrates
Project B	Pig manure, Maize, Grain
Project C	Cow manure, Maisze/Corn, Grain
Project D	Duck/Cow manure, Maize, Grain
Anlage E:	Pig manure, Maize/Corn, Grain
Anlage F:	Pig manure, Maize, Grain
Anlage G:	Mix of Manure, Maize, Grain
Anlage H:	Cow manure, Maize/Corn, Grain
Anlage I:	Cow manure, Maize
Anlage J:	Cow manure, Maize/Corn
Anlage K:	Duck/Cow manure, Maize, Grain
Anlage L:	Cow manure, Maize, Grain
Anlage M:	Cow manure, Maize/Corn, Grain
Anlage N:	Cow manure, Maize, Grain
Anlage O:	Pig manure, Maize
Anlage P:	
Anlage Q:	Gow dung/manure, Maize, Grain
Anlage R:	Pig Manure, Grain
Anlage S:	Cow dung, Pig Manure, Maize/Corn
Anlage T:	
Anlage U:	
Anlage V:	Pig manure, Maize, Grain

Biogas Plant Effluent (Liquid Fertiliser) Analysis

Anlage (Project)		A	B	C	D	E	F	G
Datum								
Total Solids content	%	4.9	6.1	6.5	3.3	2.700	5.600	2.53
Nitrogen	%	0.57	0.61	0.43	0.43	0.330	0.500	0.34
Ammonia	%	0.36	0.33	0.18	0.28	0.240	0.230	0.27
Phosphorous	%	0.26	0.27	0.13	0.23	0.080	0.170	0.11
Pottasium	%	0.38	0.51	0.34	0.35	0.400	0.410	0.27
Magnesium	%	0.07	0.08	0.06	0.06	0.030	0.060	0.05
Calcium	%	0.24	0.14	0.09	0.21	0.100	0.120	-
Sulphur	%	0.05	0.04	0.03	0.02	0.019		-
Copper	mg/kg	75.9	15.4	2.35	6.1	-	13.2	-

Project	Value	H	I	J	K	L	M	N	O	Average
Datum										
Total Solids content	%	6.7	4.7	7.8	2.4	3.7	4	3.8	8.2	4.90
Nitrogen	%	0.53	0.35	0.44	0.41	0.31	0.41	0.3	0.57	0.42
Ammonia	%	0.28	0.18	0.17	0.29	0.17	0.21	0.11	0.27	0.22
Phosphorous	%	0.22	0.14	0.18	0.12	0.11	0.09	0.09	0.24	0.16
Pottasium	%	0.49	0.36	0.45	0.36	0.27	0.33	0.32	0.49	0.37
Magnesium	%	0.07	0.06	0.08	0.01	0.04	0.02	0.04	0.09	0.06
Calcium	%	0.16	0.12	0.12	0.16	0.1	0.06	0.07	0.17	0.13
Sulphur	%	0.04	0.03	0.04	0.02	0.02	0.02	0.02	0.03	0.03
Copper	mg/kg	7.6	3.3	3.7	4.9	9	7.7	2.2	9.2	12.15

Anlage	Value	P	Q	R	S	T	U	V	V
Datum		11/4/06	13/4/06	14/4/06	13/4/06	28/4/06	28/4/06	27/4/06	7/7/06
Total Solids content	%	7.2	1.1	4.58	5.8	6.3	6.5	5.9	5.6
Nitrogen	%	0.52	0.14	0.41	0.44	0.51	0.52	0.4	0.42
Ammonia	%	0.28	0.05	0.2	0.19	0.28	0.28	0.17	0.19
Phosphorous	%	0.23	0.03	0.13	0.16	0.2	0.21	0.17	0.17
Pottasium	%	0.4	0.15	0.3	0.44	0.41	0.41	0.35	0.41
Magnesium	%	0.08	0.02	0.04	0.05	0.08	0.08	0.07	0.07
Calcium	%	0.24	0.03		0.13	0.15	0.16	0.11	0.12
Sulphur	%	0.04	0.01	0.03	0.03	0.03	0.03	0.03	0.03
Copper	mg/kg	14.4	1.2	10.4	3.3	18.1	21.9	10.5	11.8

40 KL would contain
 # 168 Kg of Nitrogen
 # 88 Kg of Ammonium
 # 64 Kg of Phosphorous
 # 148 Kg of Potassium

6.2 The System Description:

The digested effluent with a TS of 5.5 - 7% is sent through screw press/ fabric filter press to separate the solid to an extent of 3% TS remaining in the outlet liquid. Separated solid with 30-40% moisture are sent to the organic composting unit. The liquid is then passed through Flocculation system to reduce the TS to less than 150ppm. Collected Solids from the Flocculator are also sent to the organic fertilizer.

Liquid from the outlet of Flocculator is passed through Centrifuge to reduce TS level to less than 30ppm and then passed through Pressure Sand Filter to reduce TS less than detectable range.

Separated water with TS less than detectable range & TDS in the range of 10,000 to 20,000 ppm is passed through Ultra Filtration system which separates any escaped TS. From Ultra Filtration System the water is passed through Reverse Osmosis to reduce the TDS level less than 50 ppm with a recovery of 60% - 70%. Permeate water can be recycled in to the system. The reject water with an approximate TDS of greater than 40000 ppm (with dissolved ammonium & Potassium) can be used as liquid fertilizer.

6.3 Organic Fertilizer Unit Components.

The plant comprises of following operating units Viz.

Operating Unit 1 : Screw Press or **Filter Press.**

Operating Unit 2 : Flocculation Chamber

Operating Unit 3 : Centrifuge

Operating Unit 4 : Pressure Sand Filter

Operating Unit 5 : Ultra Filtration System

Operating Unit 6 : Reverse Osmosis.

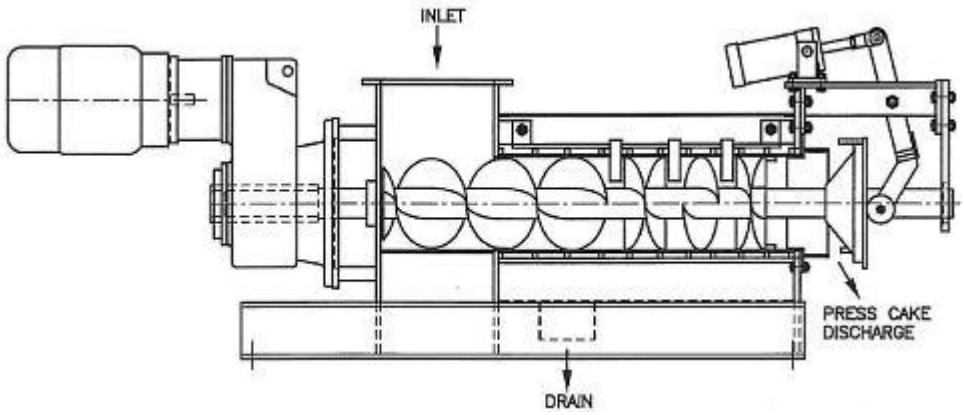
The Various operating units are described in the following section.

Operating Unit 1: Screw Press or Filter Press

Digested Effluent with TS of 5.5 - 7 % is pumped from the Intermediate Storage tank to Premixing tank where necessary chemicals are added in order to increase the coagulation properties. The premixing tank consists of horizontal mounted stirring mechanism, to provide proper mixing and continuous operation. Mixed Effluent is pumped to screw press with the help of pumps provided at the premixing tank (2 No – 1 W + 1 SB).

Screw Press or filter press separates the solid & liquid, where the TS level is reduced to 3 %. Separated solids are collected in the collection pit and conveyed to the loading section through the elevated screw conveyor. Water collected separately in a collection pit at the bottom of the Press and continuously pumped to the flocculation premixing tank.

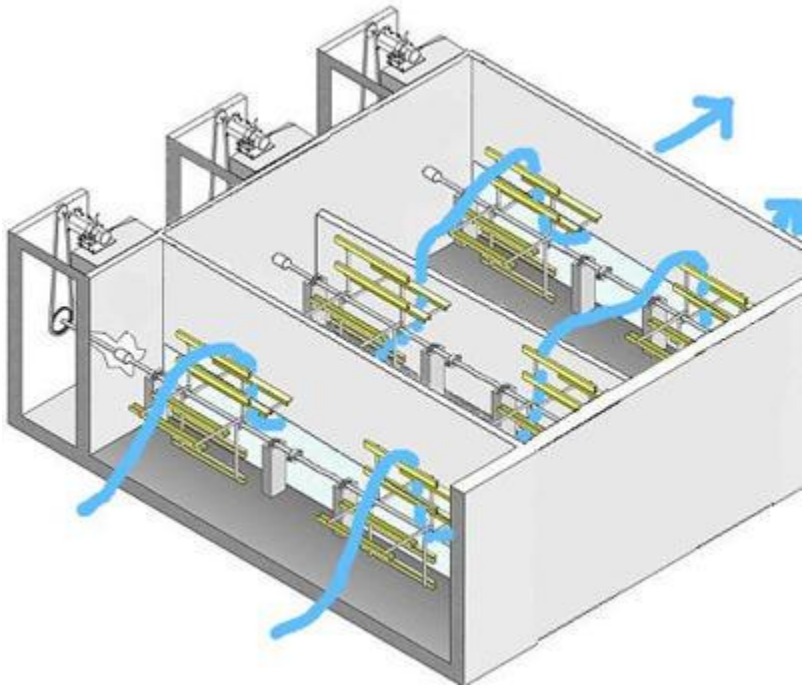
Separated solids are rich in organic nutrients and can be used as organic fertilizer composted by adding up other materials which is good for agricultural soil.



Typical Screw Press

Operating Unit 2: Flocculation Unit

Water from screw press collection pit entering in to the Flocculation premixing tank provided with mechanical agitation system and flocculating agents dozing system. The flocculating agents help's in rapid sedimentation of solids. Sedimented solids are collected at the bottom by gravitational method. Clear supernatant liquid with TS < 150 ppm is pumped to centrifuge unit with the help Pumps provided (2 Nos 1 W + 1SB) for further removal of TS.



Typical flocculation Chamber

The flocculation chambers are provided with raker arms or other slow moving impellers to increase rate of sedimentation. These raker arms or impellers are driven by motors coupled with gear mechanism.

Operating Unit 3 **:** Centrifuge

Water with TS of < 150 ppm is pumped in to the centrifuge unit to remove the TS to < 30 ppm. The process of the centrifuge is batch process and the feeding method is as follows.

- Loading the bag in to the centrifuge.
- Feeding the water in to the system up to the brim indicated.
- Closing the centrifuge unit & locking.
- Switching on the motor to rotate the basket and removing all the liquid.
- Unlocking and opening the centrifuge
- Lifting of bag and removing solids.
- Loading fresh bag.

Typical Centrifuge Unit

Operating Unit 4 : Pressure Sand Filter

Water from centrifuge is collected in the intermediate storage sump from where it is pumped to the pressure sand filter unit with the help of centrifugal pumps (2 Nos – 1W + 1SB). The Pressure sand filter which is provided with various medias inside an MS housing removes all the TS from 30 ppm to < detectable range. The pressure sand filter requires a periodical back washing in order to remove the accumulated solid on the media. Various valves and piping are provided to do periodical backwash & normal operation. Filtered Water is collected in another intermediate storage sump from where it is pumped to the Ultra filtration system.

Typical Pressure Sand Filter

Operating Unit 5 : Ultra Filtration System

Water with TS < Detectable range and TDS around 10000 to 20000 ppm enters the system. The Ultra Filtration system survives the purpose of safe guarding the next unit – RO system by avoiding any escaped TS and other foreign materials. The membrane used in the system is specially made by IMT Membranes with a 7 bore technology having multiple features & highly resistible to various fluctuations in the inlet water quality. The unit uses pumps, piping and valve mechanism to operate and can be made either fully automatic or manual.

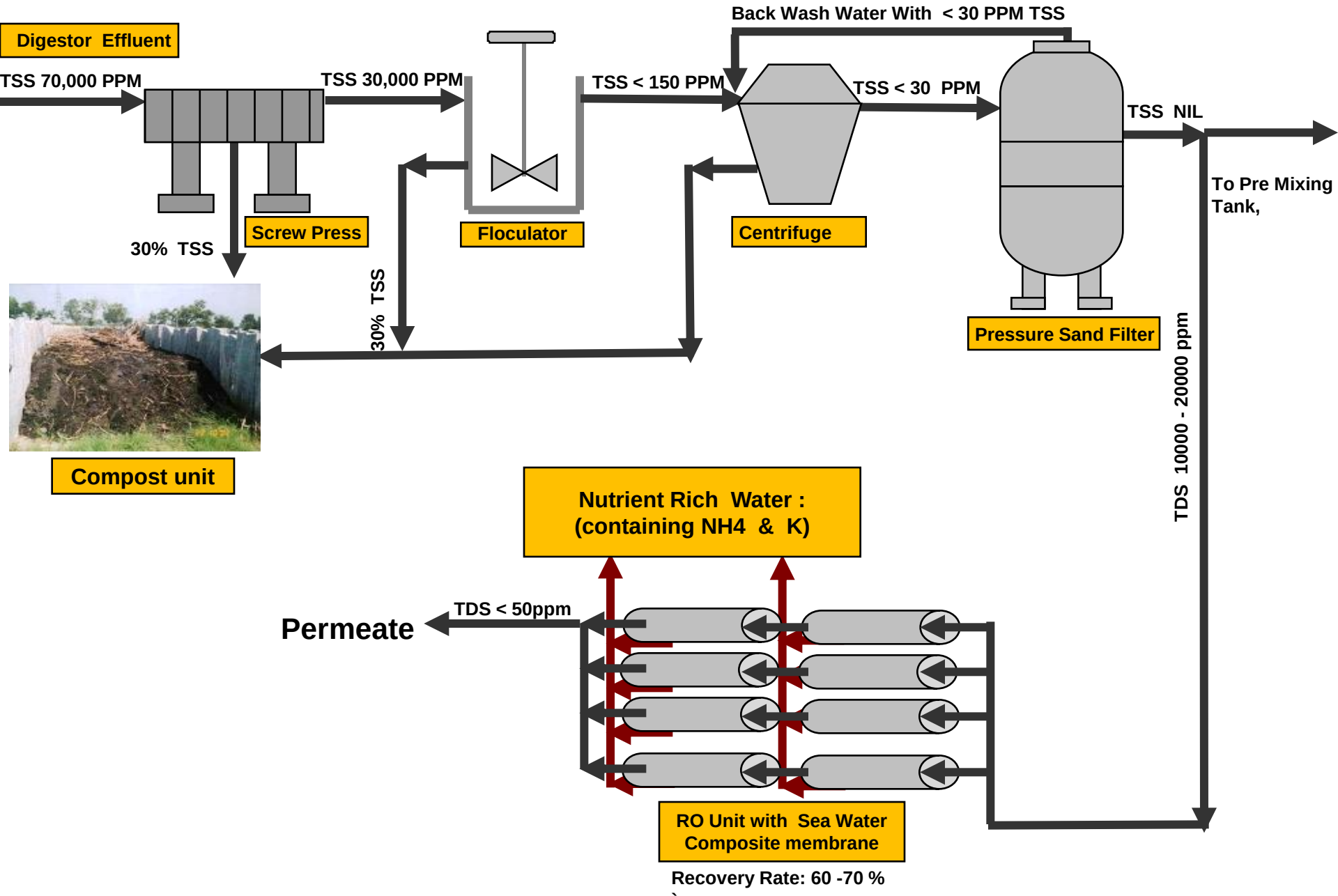
Typical Ultra Filtration system**.**

Operating Unit 6 : Reverse Osmosis System

Outlet of Ultra Filtration system which is free from TS and TDS around 10000 to 20000 ppm is stored in an intermediate storage tank from where the water is pumped in to the Reverse Osmosis System. Reverse Osmosis is the advanced technology in water treatment segment. The process is based upon the separation of dissolved solids from the water using a semi permeable membrane by applying pressure. The Semi permeable membrane allows the water molecules and other particles of size lesser than the water molecule. Treated water meets the standard norms and can be recycled in to the required process stream. The reject water which is rich in nutrients used as liquid fertilizer for agricultural fields.

Typical Reverse Osmosis System

Schematic of Organic Fertilizer Unit



APPENDICES

A) NAMAKKAL DISTRICT SURVEY REPORT – ANALYSIS FOR BIO ENERGY & ORGANIC FERTILISER POTENTIAL.

Namakkal District Survey Report -Analysis for Bio Energy & Organic Fertilizer Potential

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G.0 Poultry Litter use as Organic Fertilizer

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H.0 Summary

Executive Summary

Namakkal District Survey Report -Analysis for Bio Energy & Organic Fertilizer Potential

A.0 EXECUTIVE SUMMARY

A.1 Geographical Overview

Namakkal District is a newly formed district functioning from 01.01.1997. It is bounded by Salem on the North, Karur on the South, Trichy & Salem on the East and Erode district on the west. It lies between 11°00" and 11°36" North Latitude and 77°28" and 78°30" East Latitude. The altitude of the District is 300 metres above sea level.

Kolli hills are a preserved mountainous area of the Eastern Ghats located on the eastern border of the Namakkal District. The elevation of the central region of the hills ranges from 1000 M to 1,350 M above sea Level.

Namakkal District encompasses an area of 0.33 million hectares comprising 13% forest and more than 50% of the land used for cultivation and the rest for non-agriculture use, Barren and Fallow lands.

The most famous Cauvery River flows along the western and southern boundaries of the District while benefiting most of the cultivated lands in Pallipalayam, Tiruchengode, Kabilarmalai, Paramathi and Mohanur blocks of Tiruchengode, Paramathi Velur AND Namakkal Taluks in the District. Thirumanimuthar River flows from Vennandur Block and ends in Cauvery River at **Nanjay Idayar Village** (One of the proposed site for the plant).

A.2 District Profile

A.2.1 Basic Infrastructure

Roads & Railways: The district has well connected by road of 39 kM length of National Highways called NH-7. Apart from the above, 80kM length of state highways, 62 kM length of major District roads, 342 kM length of other District roads are available for Transport. About 15 kM length of railway lines passes through the western border of the district. Laying of new railway line from Salem to Karur via Rasipuram, Namakkal and Mohanur is in progress and will be completed by 2010.

Electricity Supply: Namakkal District Electricity supply is by Tamil Nadu Electricity Board (TNEB). It receives power at 220 kV and stepped it down to 110 kV to further distribute to the sub-stations mentioned in table below.

Table – 1: Sub-station details

Sl No.	Sub-station Name	Tr. Rating, MVA	Total Capacity, MVA
1	Namakkal, 110/22 kV S/s	3x16	48
2	Valayapatti, 110/22 kV S/s	2x10	20
3	K N Patty, 110/22 kV S/s	2x10	20
4	Thiruchengode, 110/22 kV S/s	2x16	32
5	Mallasamudram, 110/22 kV S/s	2x16	32
6	Elanagar, 110/22 kV S/s	2x10	20
7	Nallur, 110/22 kV S/s	2x16	32
8	Kabilarmalai, 110/22 kV S/s	2x10	20
9	Komarapalayam, 110/22 kV S/s	2x16	32
10	Pallipalayam, 110/22 kV S/s	2x25	50
11	Unjanai, 110/22 kV S/s	2x100	200
		1x16	16
12	Valavanthi, 110/22 kV S/s	2x10	20
13	Erumapatty, 110/22 kV S/s	1x16	16
14	Puduchanthai, 110/22 kV S/s	2x10	20
15	Paramathy – Velur, 110/22 kV S/s	1x10	10
TOTAL			**588**

Source: Govt. Statistical Dept. – Hand Book

The entire 334 village Panchayats is electrified. The above sub-stations cater power to about 500 small scale industries and 54,000 agriculture pump sets in the district besides catering power to the domestic and other commercial applications in the rural and urban areas. The district power demand is about 300 MW and annual energy requirement is about 900 Million units.

Educational & Vocational Training Institutes: The District is emerging as educational centre for General, Technical and Vocational education. It consists of fourteen Engineering colleges, one Veterinary college, ten Polytechnics, thirty five other colleges and one thousand two hundred forty six schools.

A.2.2 Demographic Data

As per the 2001 census, the total population of the district is 1.49 Million out of which 0.75 Million are males and 0.73 Million are females. Nearly 0.948 Million person are living in rural areas which accounts for 63.5 % of the total population. And 0.54 Million are living in urban areas i.e 36.5 % of the total population.
The main occupation of the rural population is Agriculture and agriculture related activities.

A.3 Agriculture / Farming sector overviews

A.3.1 Natural Resources

Climatic: Namakkal District experiences semi-arid tropical climate wherein four distinct seasons viz: South west monsoon (June - Sept), North east monsoon (Oct - Dec), winter season (Jan-Feb) and summer season (Apr – May) are experienced.

Temperature: The Maximum temperature ranges from 28 ^{o}C to 40 ^{o}C (April – May) and the minimum temperature from 14 ^{o}C to 26 ^{o}C (Jan – Feb).

Sunshine Hours: Sunshine hours are long during February to May ranging from 8.4 to 9.5 Hours. During August to October, it ranges from 6.3 to 6.8 hours per day.

Rain fall: The average rainfall is about 776 mm. Nearly 80% of the rainfall received during South west monsoon and North east monsoon.

C.2. Agriculture

Agriculture continues to be the most predominant sector of the district as more than 60 % to the population is engaged in agriculture and allied activities.

Land Utilization Pattern: The total 0.336 Million hectares of land utilization has been summarized in the table below.

Table – 2: Land utilization pattern

Sl No.	Classification of land	Area, Ha	%age in Use
1.	Forest	43,909	13 %
2.	Net Cropping Area	176,544	53 %
3.	Permanent Pasture	6,684	2 %
4.	Miscellaneous Tree Crops (Not included in Net Area Sown)	3,854	1 %
.5.	Barren & Uncultivable	24,743	7 %
6.	Fallow Land	37,518	11%
7.	Land Put on Non-Agricultural uses	38,302	12 %
8.	**Geographical Area**	**336,335**	**100 %**
9.	Gross Cropping Area	205,689	
10.	Area Sown More than once	29,145	

Source: Annual Report 07-08, Dist. Rural Development Agency, Namakkal

Soil Classification: The type of soil in Namakkal District is categorized in various blocks as Red loam, Clay loam, Black soil, Laterictic and Sandy coastal alluvium. Black soil exists across the River bed areas and red loam, clay loam, red soil persists in other parts of the District which is good for perennial crops. The details of soil type in various blocks of Namakkal District are summarized in the table below.

Table – 3: Type of Soil in Namakkal District

Sl No.	Name of the Block	Type of Soil	Remarks
1	Namakkal	Red Loam	Mineral rich
2	Puduchatram	Red Loam & Red Sandy Soil	Mineral rich
3	Sendamangalam	Clay loam	Sticky and holds more water. Hence Good for perennial crops
4	Erumapatty	Black Soil & Clay loam	Good for irrigation
5	Mohanur	Black Soil	Good for irrigation
6	Kollihills	Lateritic Soil	Red soil. Good for perennial crops & short-term crops like vegetables.
7	Paramathy	Red Loam	Mineral rich
8	Kabilarmalai	Black Soil & Sandy coastal Alluvium	Good for irrigation
9	Tiruchencode	Red Loam	Mineral rich
10	Pallipalayam	Red Loam & Black Soil	Mineral rich & good for irrigation
11	Elachipalayam	Red Loam	Mineral rich
12	Mallasamudram	Red Loam	Mineral rich
13	Rasipuram	Red Loam	Mineral rich
14	Vennandur	Clay loam	Sticky and holds more water. Hence Good for perennial crops
15	Namagiripet	Black Soil	Good for irrigation

Source: Dept of Agriculture, Namakkal. www.namakkal.tn.nic.in/agri.htm

Cropping Pattern: Sugarcane, Betalvine, Tapioca are grown as single crop. Betalvine sowed during June –July where as Tapioca sown in December. Sugarcane sown during Dec –Jun.

Paddy & Millets are grown as double crops in irrigated areas. Paddy is sown in Aug – September, millets or pulses sown in February as a second crop.

Dry land single crops: Millets are sown in May – June and pulses are sown in August – September.

Irrigation: The famous Cauvery River flows along the western and southern boundaries of the District. It benefits most of the cultivated lands in Pallipalayam, Tiruchengode, Kabilarmalai, Paramathi and Mohanur blocks through Mettur Canal, Raja Vaikkal, Mohanur Vaikkal and Kumarapalayam Vaikkal. River Thirumanimuthar starts from Yercaud hills of Salem District and flows through Namakkal District starting from Minnakkal village of Vennandur Block and ends in the Cauvery River via. Najay Idayar Village of Paramathy Taluk. There exists 16 Anaicut (Check dams) across the river and 18 numbers of Tanks are fed by these anaicuts. Source wise irrigation details are summarized in the table below.

Table – 4: Source wise Area Irrigation

Sl. No.	Source	Net area Irrigated, Ha	% age
I	**Surface Water**		
	Canals	6,147	8.3 %
	Tanks	4,198	5.6 %
II	**Other Sources** Flow Irrigation	6,127	8.2 %
III	**Ground Water**		
	Private Tube Wells	6,745	9.0 %
	Open wells	51,101	68.8 %
Total		**74,318**	

Size of Land Holdings: There are around 0.15 Million land holdings in the district occupying 85% of the total area. Most of the land holdings are marginal and small farmers. The percentages of marginal and small holdings are 55 % and 25 % respectively.

Area under Principal Crops: Principal crops cultivated in Namakkal District are Paddy, Millets, Sugarcane, pulses and oil seeds. Over the years there is a reduction in area of Rice, pulses and oil seeds while steady increase area of Millets, sugarcane till 2005-06. Since 2006-07 & 2007-08, there is a drastic increase in Millets growing area with more than 100% compared to 2005-06. Similarly, vegetables and fruits is steadily increasing since 2004-05. The details are summarized in the table below.

Table – 5: Area under principal crops

No.	Crop	1997	1998	1999	2000	2001-05 *	2004-05	2005-06	2006-07	2007-08
1	**Rice**	**0.25**	**0.24**	**0.25**	**0.22**	**0.13**	**0.09**	**0.19**	**0.27**	**0.21**
2	Sorghum	0.19	0.21	0.10	0.09	0.22	0.25	0.30	-	-
3	Maize	0.01	0.01	0.01	0.01	0.01	0.02	0.02	-	-
4	Tapioca	NA	NA	NA	NA	NA	NA	0.22	-	-
5	Other millets	0.06	0.05	0.04	0.04	0.02	-	0.01	-	-
	Total Millets	**0.26**	**0.27**	**0.15**	**0.14**	**0.25**	**0.27**	**0.55**	**1.11**	**1.20**
5	Red gram	0.09	0.09	0.08	0.10	-	0.01	0.01	-	-
6	Black gram	0,08	0.09	0.09	0.10	-	0.04	0.01	-	-
7	Green gram	006	0.06	0.07	0.08	-	0.09	0.04	-	-
8	Other Pulses	0.08	0.08	0.10	0.10	-	0.04	0.01	-	-
	Total Pulses	**0.32**	**0.32**	**0.34**	**0.38**	**0.20**	**0.18**	**0.07**	**0.24**	**0.19**
	Total Food Grain	**0.83**	**0.83**	**0.75**	**0.74**	**0.58**	**0.54**	**0.59**	**1.62**	**1.60**
9	Groundnut	0.80	0.76	0.68	0.73	0.50	0.48	0.48	-	-
10	Castor	0.12	0.11	0.10	0.13	0.02	0.03	0.03	-	-
11	Other Oilseeds	0.07	0.06	0.04	0.03	0.07	0.04	0.03	-	-
	Total Oil Seeds	**0.99**	**0.93**	**0.82**	**0.89**	**0.59**	**0.55**	**0.54**	**0.55**	**0.48**
12	Cotton	0.03	0.04	0.02	0.03	0.03	0.04	0.03	0.07	0.03
13	Sugar Cane	0.09	0.09	0.10	0.10	0.11	0.10	0.13	0.19	0.17
	Total	**1.93**	**1.89**	**1.69**	**1.76**	**1.31**	**1.23**	**1.54**	**2.43**	**2.28**
	Vegetables	-	-	-	-	-	0.21	0.26	0.29	NA
	Fruits	-	-	-	-	-	0.04	0.05	0.06	NA

Source: Dept. of Agriculture, Namakkal

Growth Trend: Though the District had set a target rate of 4.5 % in agriculture during the Ninth Plan period, it has registered an annual growth rate of 6.21 %.

The total milk production in the District is 0.26 Million tons per annum. Meat is also fairly high. Annually 3,980 Million eggs are produced which is around 60% of the state egg production. The livestock sector is growing at 4% rate while poultry is growing at 10%.

With the present growth rate, the growing demand for poultry ingredients especially millets, the growth in agriculture sector is predicted to be around 6% and prospect for agriculture seems to be very good.

A.3.2 Animal Husbandry

Livestock Population: Animal husbandry contributes significantly in supplementing the income of small and marginal farmers and landless laborers. As per the 17th Quinquinnial Livestock census, the total cattle population of the district is 0.39 Million, sheep 0.14 Million, and goat 0.37 Million.

Milk Societies: There are about 469 Milk Societies are functional in the District while producing 0.14 Million liters of milk per day.

Poultry Farming: Nearly 600 poultry farms are functioning in the District having 19 million birds producing 10 million eggs per day. Since it produces major share of eggs in the state of Tamil Nadu and sent all over India and exported to other countries, Namakkal is called as 'Egg city'. The Taluk wise poultry farming details are summarized in the table below.

Table -6: Taluk wise Poultry Farming details (2006-07)

Taluk	No. of Farms	No. of Birds	Eggs produced per day
Namakkal	310	1,25,22,030	6,636,676
Rasipuram	110	27,00,790	1,431,419
Paramathi - Velur	48	14,35,816	760,982
Tiruchencode	120	27,96,690	1,482,246
Total	**588**	**19,455,326**	**10,311,323**

Source: Asst. Director of Statistics, Namakkal

On an average nearly **1000 Tons of poultry waste available per day** @ 50gms/day/bird.

A.4 Trends in use of Fertilizer (Organic & Inorganic).

A.4.1 Potential Availability of Organic Manure

The total cropped area of the District is around 0.2 Million hectares. Even if the manure requirement per hectare is 12.5 MT, the total requirement per annum will be 2.57 Million MT. During 2006, the total quantity was available 2.27 Million MT. About 20% of the manure is used for the applications other than agriculture like: Biogas feed, fish feed, etc. The rest was used in agriculture. About 60% of the poultry manure has been sold and transported to neighboring Kerala State for use in plantation crops.

Over the last two decades, farmers have become increasingly dependent on chemical fertilizers for obtaining quick higher grain yields to meet the demands of enlarging population. Annual consumption of chemical fertilizers (NPK) during 2006-07 was 23,252 MT. The price of chemical fertilizers was subsidized, thereby enabling farmers to apply maximizing doses.

A.4.2 Potential Availability of Crop Residues.

Crop residues are the plant parts remaining in a field after harvest of a crop, which include stems, leaves, etc. Agricultural crop residues include sorghum straw, rice straw, sugarcane trash and processing residues. Out of the total quantity, 50% is normally used as dry fodder for livestock especially rice straw, sorghum straw. The remaining residues are available for utilization in agriculture or burnt in the field. From the low density crops, surplus residue availability is estimated to be around 0.1 million tons after usage of livestock fodder.

A.5 Initiatives in Organic Farming

In order to switch over from the usage of chemical inputs that are hazardous to human health, awareness is being created among the farming community to use organic inputs by various organizations.

A.5.1 Government Initiatives.

Organic farming in the district is in infant stage. The government department of Agriculture has initiated the activities related to organic farming under the National Programme for Organic Farming. The Department of Agriculture is also rendering the following services indirectly towards the promotion of organic farming through the following institutes.

- Sugarcane Parasite Breeding Station, Mohanur
- Coconut Parasite Breeding Station, Velur
- Bio Control Lab - Namakkal

The Govt. of Tamil Nadu has outlined the following schemes to promote organic farming at an outlay of Rs. 28.2 Million.

- Scheme on Bio-fertilizer distribution under 50% subsidy
- Scheme on composting of farm waste through Pleurotus (Rs. 1.2 Million)
- Vermi composting of Agriculture wastes (Rs. 1.6 Million)
- Green Manure Scheme (Rs. 19.4 Million)

A.5.2 Initiatives by NGOs

There are 19 registered NGOs in the Namakkal District. About 10 NGOs are involved in organic farming through training and workshops on solid waste management for efficient recycling of organic wastes & vermi composting.

A.5.3 Promotion of organic farming by MS Swaminathan Research Foundation

The foundation has taken up initiatives on promotion of organic cultivation of fruits and vegetables, minor millets and spices in Kolli Hills region.

A.5.4 Organic farming by Individual farmers.

There are few farmers and organizations are practicing organic farming at 10 hectares of irrigated land. Their products are sold in local market. But they have not gone for any certification.

A.5.5 Demand for organically grown Food.

Several buyers have shown interest in purchase of organically grown products. Pine apple farmers have earned Rs. 1.5 Million including an export of worth Rs. 0.01 Million. Spices and other food products are in great demand. The retail networks like Reliance Fresh, Food World, Wallmart, Amudham, etc of the neighboring districts are purchasing organic produces from Namakkal.

A.5.6 Organic feedstock for livestock / Poultry

The first step in organic livestock production is the organic fodder production. At present though the demand for organic fodder and feed for livestock is negligible, the demand for the same is expected to increase many times in the near future as the demand for organic milk and meat are slowly increasing for export purposes.

Poultry population is increasing year by year and the industry is growing at the rate of 10% and with this growth, requirement for millets especially maize for poultry feed is increasing. Organic

eggs are being marketed to foreign countries and for production of organic eggs, millets produced organically is essential. Hence there is a great scope for organic millets as feed for poultry for production of organic eggs for both eggs and egg powder.

A.6 Poultry Litter use as organic Fertilizer

The poultry litter is estimated to be about 0.6 Million tons in Namakkal District. Disposal of manure immediately that removed from the poultry house is an issue due to distant transport. Therefore manure is stored for more than a month before disposal in turn which reduces nutrient values. Hence for quick disposal to avoid loss of nutrients and environmental pollution, the manure can be recycled principally in the following ways.

- Energy Generation
- Land application as plant nutrients to crops

A.6.1 Types of Poultry Litter

Deep Litter: Manure produced by layers during the laying period. Deep litter usually consists of peanut hulls, rice husk or wood shavings in a layer of 10-15 cm deep. During production accumulated manure gets mixed with the litter. When excreta added, the litter becomes moist but remains aerobic. Aerobic fermentation occurs with the production of heat and loss of CO_2 & Ammonia.

Broiler House Litter: This is similar to deep litter manure but the litter is changed more frequently and there is less ammonia loss because of restricted decomposition. This results in richer in N than deep litter manure.

Cage Manure: This manure contains 70-80% moisture since it is not mixed with litter materials. Enormous loss of ammonia occurs in this manure if it is not used as the earliest. Litter is not used when birds are used in cages or slots.

A.6.2 Nutrient Content:

Nutrient values of poultry manure vary considerably depending upon the conditions under which it is processed. The ratio of litter to manure and the moisture content causes considerable variation among manures from different houses. In fresh poultry excreta, uric acid or urate is the most abundant nitrogen compound (40-70% of total N) while urea and ammonium are present in small quantities.

A.6.3 Issues related to storage & Handling

Some of the issues related to storage & handling are summarized below;

- Ammonia Emission
- Nitrate Pollution
- Surface water contamination
- Under ground water contamination
- Fly attraction and breeding
- Public nuisance

A.6.4 Processing of Poultry Litter

There are several commonly practiced methods of storing poultry manure, each of which could affect the quality of the manure at the time of application. “Drying” improves the physical characteristics of poultry manure while achieving acceptable N conservation.

A.6.5 Composting Poultry Litter

Controlled biological decomposition of organic waste has been proved as a method of stabilizing poultry manure prior to land application. This process produces a material with several advantages with respect to handling by reducing volume, mass of dry matter, odors, fly attraction and breeding and weed seed viability. Composting poultry manure and poultry carcasses with straw as carbon source successfully decomposes the manure and carcasses and produces a stable organic material physically and chemically similar to the manure used in composting process.

A.6.6 Effect of Application of Poultry Manure

Soil physical properties: Poultry manure improves the physical properties of the soil. It significantly decreases bulk density and increases total porosity, infiltration capacity and water holding capacity.

Nutrient Availability: Poultry manure is a better source for all plant nutrients than other manures. It increases the available N, exchangeable K and decreases the adsorption capacity and increases the soluble P.

Nutrient uptake: Addition of poultry manure either alone or in combination with N, P and K increases the uptake of N, P and K in many crops.

Yield Crops: Application of poultry manure helps to increase the yields of many crops mainly due to the ability to supply all the nutrients required for crop growth.

Residual Effects: Application of poultry manure to the first crop has significant residual effect on succeeding crop yield and also increases the nutrient content of the soil.

B.0 GEOGRAPHICAL OVERVIEW

INTRODUCTION:

The Namakkal District, initially part of the Salem district, was founded in 1997. Namakkal district encompasses an area of 0.33 Million hectare and has a population of approximately 1.5 million people, with a gender ratio of 967 females per 1000 males. Namakkal district is comprised of four Taluks; viz, Tiruchengode, Rasipuram, Paramthi- Velur, and Namakkal; fifteen blocks, twenty town panchayats, and three hundred and thirty four village panchayats. Several industries are largely responsible for sustaining Namakkal's economy. They are: 1) Transport and trucking 2) Poultry and dairying 3) Sago and starch-based industries and 4) Textiles. Certain industries have a larger presence in particular Taluks.

Namakkal District is a newly formed district functioning from 01.01.1997. Namakkal find a place of importance in the map of India because of its lorry body building industry, a unique feature of the town. Therefore it is called "Transport City". Since it produces major share of eggs in the state which are sent to all over the country and also, outside the country, Namakkal is also called as 'Egg city'

LOCATION AND PHYSIOGRAPHY:

Namakkal District is bounded by Salem on the north, Karur on the south, Trichy and Salem on the east and Erode district on the west. Namakkal District is situated on the north-eastern part of Tamil Nadu at 11 ^{o} 00' and 12 ^{o} 00' of the North latitude and 77 ^{o} 40' and 78^{o}05' of the East longitude. The altitude of the district is 300 metres above mean sea level.

Namakkal District comes under the North Western Agro climatic zone (excluding Tiruchengode Taluk) of Tamil Nadu. It is situated in the dividing portion of two watersheds between Cauvery and the Vellar System with the Taluks of Attur, Rasipuram and Namakkal on the east and Salem, Omalur and Mettur on the west. Tiruchengode taluk alone is placed under Western Agro - climatic zone.

Besides the above two zones, Kollihills in Namakkal and few isolated hills and ridges scattered over Namakkal, Rasipuram and Tiruchengode along with the valleys and rolling topography contributes to the characteristic physiography of the district.

Kolli hills, the Garden of Namakkal district comprising of 14 village panchayats called 'Nadu' is having an area of 371.03 sq. km at an altitude of 1300 mts. above MSL.

The northern portion of Namakkal is mountains and the southern areas are plains. The plain area of the district can be divided into 3 elevating stages. The lower elevation (below 150 m) has Namakkal and Paramathi Taluks which are being benefited by Cauvery River. The mid elevation (150-300 m above M.S.L.) occupies the major area in all Taluks. The high elevation area (between 300-600 m) spreads over mainly in Rasipuram and Namakkal Taluks. The chief rivers running through in the district are Cauvery and Thirumanimuthar. The Cauvery flows towards south and south west hugging the border.

The famous Cauvery River flows along the western and southern boundaries of the district at an elevation of 150 m. It benefits most of the cultivated lands in Paramathi and Mohanur blocks. Its tributaries are Sarabanga and Tirumanimuthar.

Kolli Hills

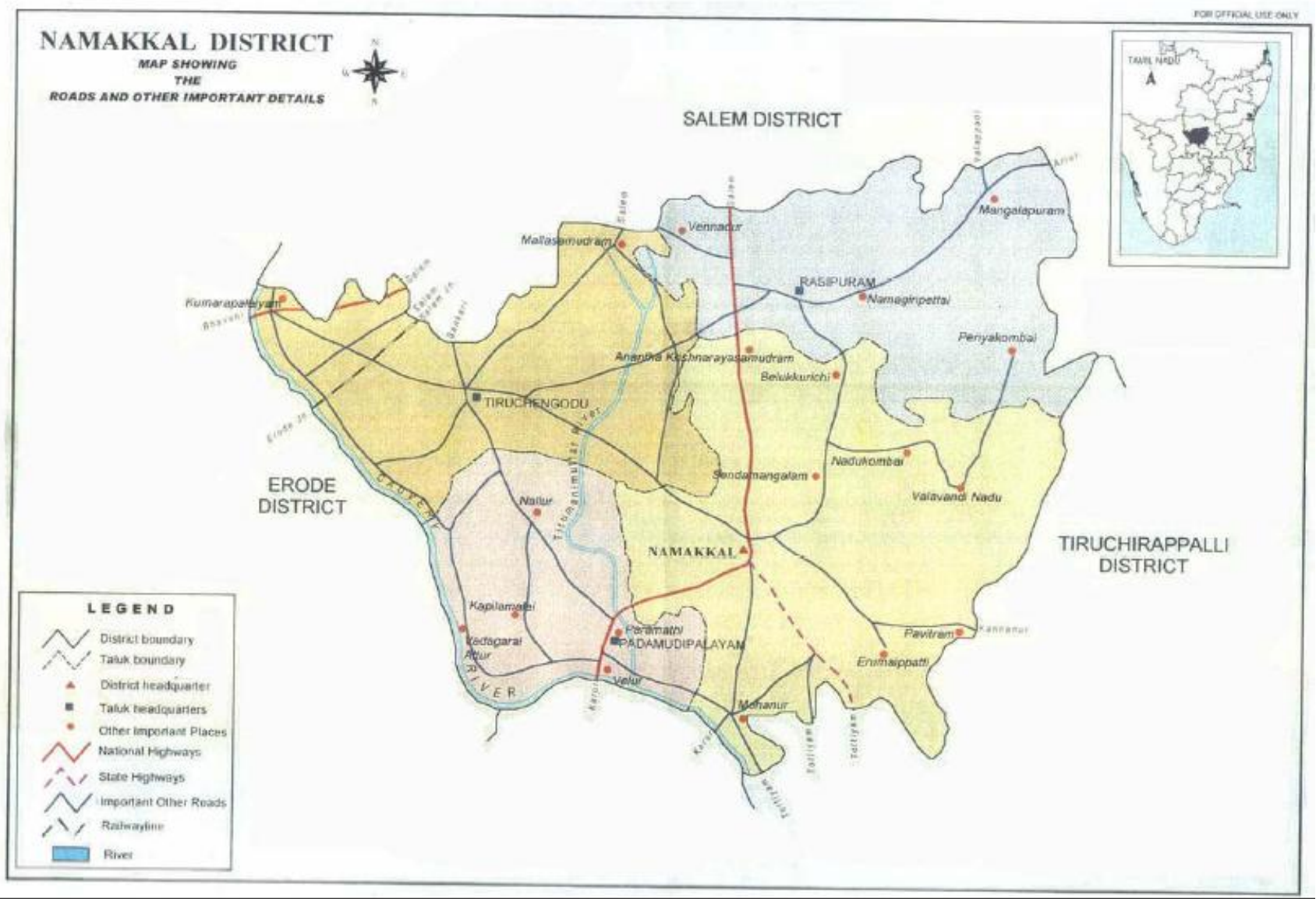
Kolli Hills (*Kollimalai* in Tamil) is a preserved mountainous area of the Eastern Ghats located on the eastern border of the Namakkal District. The elevation of the central region of the hills ranges from just under 1,000m to 1,350 m above MSL. The maximum temperature ranges from 20-30º C, while the minimum lie between 10- 20ºC. The average annual precipitation in the region is about 1,440 mm, which also exceeds the state average.

Kolli Hills itself can be divided into two main physical components: the periphery and the central part. The periphery is covered with uninhabited preserved natural forest lying on more or less steep slopes and largely contributes to the rich biological diversity attributed to the region. The central part is inhabited and is covered mostly by agricultural or agro-forestry area, as a replacement to what used to be only forests. Overall, forests occupy 44 percent of the total area of 28,293 ha, while agricultural activities take place in 52 percent of the area, leaving 5 percent for other activities.

The estimated 50,000 population of the Kolli Hills is distributed in fourteen administrative village clusters (*nadus* or *panchayats*). The whole region is linked to the rest of the Namakkal district by only one paved road on the south west of the hills that leads to the hamlet of Semmedu in the Valavanthi Nadu. Semmedu is also where the government departments are located.

TAMIL NADU DISTRICTS

FIG 1. LOCATION OF NAMAKKAL DISTRICT


FOR OFFICIAL USE ONLY
NAMAKKAL DISTRICT
MAP SHOWING
THE
ROADS AND OTHER IMPORTANT DETAILS
TAMIL NADU
SALEM DISTRICT
Mallasamudram
Vennandur
Mangalapuram
RASIPURAM
Namagiripettai
Periyakombai
Kumarapalayam
Ananda Krishnarayasamudram
Belukkurichi
TIRUCHENGODU
Nadukombai
Sendamangalam
Valavandi Nadu
ERODE
DISTRICT
Nallur
NAMAKKAL
TIRUCHIRAPPALLI
DISTRICT
Kapilamalai
Paramathi
Vedasanai
Attur
PADAMUDIPALAYAN
Pavitram
Ennaippatti
Velur
Mohanur
LEGEND
District boundary
Taluk boundary
District headquarter
Taluk headquarters
Other Important Places
National Highways
State Highways
Important Other Roads
Railwayline
River

C.0 DISTRICT PROFILE

C.1 BASIC INFRASTRUCTURE

(i) ROADS, RAILWAYS:

Namakkal find a place of importance in the map of India because of its Lorry body building industry, a unique feature of the Town. Therefore it is called ”Transport City”. The district had well connectivity of Road nearly 39 kM length of two National highways called NH7 and NH47 passes through the district. Apart from the above 80km length of state high ways, 62 kM length of major district roads, 342 kM length of other district roads are available for road transport.

Only 15 km length of Railway lines passes through the western border of district. Laying of new Railway line from Salem to Karur (Via) Rasipuram, Namakkal and Mohanur is in progress and will be completed before 2010.

(ii) ELECTRICITY SUPPLY:

Namakkal electricity supply is by TNEB and details of the same are summarized below.

TNEB SUBSTATIONS IN NAMAKKAL DISTRICT

YEAR : 2006-2007

Sl No.	Name of the Stations/Sub Stations	Capacity, MVA
1	Namakkal, 110/22 kV S/s	3x16
2	Valayapatti, 110/22 kV S/s	2x10
3	K N Patty, 110/22 kV S/s	2x10
4	Thiruchencode, 110/22 kV S/s	2x16
5	Mallasamudram, 110/22 kV S/s	2x16
6	Elanagar, 110/22 kV S/s	2x10
7	Nallur, 110/22 kV S/s	2x16
8	Kabilarmalai, 110/22 kV S/s	2x10
9	Komarapalayam, 110/22 kV S/s	2x16
10	Pallipalayam, 110/22 kV S/s	2x25
11	Unjanai, 110/22 kV S/s	2x100
		1x16
12	Valavanthi, 110/22 kV S/s	1x10
13	Erumapatty, 110/22 kV S/s	1x16
14	Puduchanthai, 110/22 kV S/s	2x10
15	Paramathy – Velur, 110/22 kV S/s	1x10
	TOTAL	**588 MVA**

The above substations cater to maximum demand of 300 MW and annual electricity supplies of 900 million kWh.

There are nearly 500 small scale industrial units with key sectors being Food Processing, Textiles, Machine building.

All the 334 villages Panchayats are Electrified. Nearly 54,060 agriculture pump sets are energized.

(iii) EDUCATION AND VOCATIONAL TRAINING INSTITUTES:

Namakkal District is an emerging educational centre for General, Technical and Vocational education. Students from many parts of Tamil Nadu and from other states came to Namakkal for secondary education and Technical Education.

Table - 4
EDUCATIONAL INSTITUTIONS IN NAMAKKAL DISTRICT.

Sl. No.	Type of Institution	No. of Institutions
1	Primary Schools	915
2	Middle Schools	171
3	High School	67
4	Higher Secondary School	93
5	Arts and Science College	19
6	Engineering Colleges	14
7	Veterinary College	1
8	College of Education	16
9	Polytechnics	10

C.2 DEMOGRAPHIC DATA

(i) FEATURES OF POPULATION:

As per 2001 census the total population of the district is 14,93,462 out of which 759551 are males and 733911 are females.

(ii) RURAL AND URBAN POPULATION:

Nearly 948230 persons are living in rural areas which accounts for 63.5% of the total population, and 545232 persons are living in Urban areas ie 36.5% of the total population.

(iii) WORK FORCE:

Total main workers of the district as per 2001 census are 770,940 and marginal workers are 71,700. Out of the total workforce (both main and marginal workers) nearly 21% are cultivators, 32% are Agricultural labours, 6% are engaged in household industry. The rural people are mainly engaged in agriculture activities except in Thiruchengode and Pallipalayam blocks were in power loom is one of the major sectors providing employment to the rural people.

Table – 6
Category wise No. of workers

Category of workers	Total	Male	Female	Percentage
Workers	842640	489002	353638	56.42
Main Workers	770940	463412	307528	51.62
Main Cultivators	171838	95385	76453	22.29
Main Agricultural labourers	222900	102783	120117	28.91
Main Workers in household industries	45201	23304	21897	5.86
Main Other Workers	331001	241940	89061	42.93
Marginal Workers	71700	25590	46110	4.8
Marginal Cultivators	6879	2495	4384	9.59
Marginal Agricultural labourers	42859	13488	29371	59.78
Marginal Workers in Household industries	5337	1135	4202	7.44
Marginal Other Workers	16625	8472	8153	23.19
Non Workers	650822	270549	380273	43.58

D.0 OVERVIEW OF THE AGRICULTURAL / FARMING SECTOR OVERVIEW

D.1 NATURAL RESOURCES:

❖ Climate:

Namakkal District experiences semi-arid tropical climate wherein four distinct seasons viz., South West monsoon (June – Sep.) North East monsoon (Oct – Dec.) Winter season (Jan. – Feb.) and Summer season (April – May) are experienced. The maximum temperature ranges from 28 ^{o}C to 40 ^{o}C and the minimum from 14 ^{o}C to 26 ^{o}C. During January and February, the lowest temperatures are recorded while maximum temperature is recorded during April - May. The rainfall during this period will be very less when compared to other periods.

The summer period starts from March and ends by May. This is the period that the temperature is usually high in the district. During this period, rains, isolated thunder showers accompanied by gale winds are observed. About 19% of the total annual rainfall is received during this period, which helps to take up sowing of rain fed crops well in advance. If the summer showers fail, the district normally experiences water scarcity for drinking.

The hot climate subsidies when the South West monsoon sets in, usually during June. About 40% of annual rainfall is recorded during this period. Farmers are able to raise paddy nurseries with the help of these rains. The remaining unsown rainfed areas are also brought under cultivation during this period. North east monsoon which prevails from October to December gives 40.5 % of annual rainfall. This helps the farmer to take up second crop under rainfed condition. The cold weather generally commences in December after the cessation of North East monsoon rains. The minimum temperature of 15-16 ^{o}C recorded during December to February generally affects the pollination in cereals particularly Rice.

❖ Temperature:

Table - 7. Maximum and minimum temperature ranges are as follows:

Month	Maximum	Minimum
April – May, July, August	37.0 ^{o}C	24.5 ^{o}C
Sept, Oct. November	31.8 ^{o}C	22.3 ^{o}C
December and January	30.5 ^{o}C	19.0 ^{o}C

❖ Relative humidity:

In general, the district records higher relative humidity due to the presence of surrounding hill areas. Relative humidity variation between day and night is higher resulting in higher probability of pest and disease incidences.

❖ Wind:

From October to March, wind blows generally from North easterly and easterly directions. South westerly and westerly winds predominate from May to September. The wind speed is the least in October to February, while it is higher from July to September.

❖ **Sunshine hours:**

The sunshine hours are generally long during February to May ranging from 8.4 hours to 9.5 hours per day. During August, September and October, it ranges from 6.3 to 6.8 hours per day.

❖ **Rainfall:**

The average annual rainfall of the district is 776 mm (Table - 8). Nearly 80 percent of the total rainfall is received during the SWM and NEM season. Among these two seasons, SWM receives 40% of rainfall and NEM 40.6%. Summer season records 19.1% of the total rainfall. The winter season receives only 0.3% of the total rainfall. Among the months, September and October receives more rainfall (125.8 and 124.7 mm respectively) followed by November (95.0 mm) and August (92.5mm). Since rainfall distribution is bi-modal in nature and the quantity of rainfall received during the SWM and NEM is sufficient for raising rainfed crops, two crops are recommended per year.

Table 8. Normal Rainfall (mm)

Sl No	Taluk	Mean annual rainfall	South West Monsoon (Jun-Sep)		North East Monsoon (Oct-Dec)		Winter (Jan-Feb.)		Summer (Mar-May)	
		mm	mm	%	mm	%	mm	%	mm	%
1	Namakkal	986	406.6	41.2	376.2	38.2	7.2	0.7	196.0	19.9
2	Paramathi	527	176.2	33.5	262.1	49.7	1.0	0.2	87.7	16.6
3	Tiruchengode	939.6	347.4	37	399.8	42.6	1.2	0.1	191.2	20.3
4	Rasipuram	651.6	310.9	47.8	221.6	34	0.9	0.1	118.2	18.1
	Mean	**776**	**310.3**	**40**	**314.9**	**40.6**	**2.6**	**0.3**	**148.2**	**19.1**

D.2 AGRICULTURE

Though noted for poultry and transport, the district is by no means backward in the field of agriculture. The main occupation of the district is agriculture. The cultivation mainly depends on monsoon rains, wells and tanks**.** Livestock rearing and poultry farming are integral parts of agriculture in this district.

Agriculture continues to be the most predominant sector of the district, as 70% of the population is engaged in agriculture and allied activities for their livelihood. The district has as an area of 0.33 Million ha with a gross cropped area of around 0.20 Million ha with a cropping intensity of 1.2. The Government's policy and objectives have been to ensure stability in agricultural production and to increase the agricultural production in a sustainable manner to meet the food requirement of growing population and also to meet the raw material needs of agro based industries, thereby providing employment opportunities to the rural population. Namakkal district has all along been one of the districts with a creditable performance in agricultural production with the farmers relatively more responsive and receptive to changing technologies and market forces.

❖ Land Use Pattern

Table - 9. Land use pattern (2006-2007)

No	Classification	Area (ha)	%
1	Forest	43909	13
2	Barren and Uncultivable uses	24743	7
3	Land put to Non-Agricultural uses	38302	12
4	Cultivable Waste	4781	1
5	Permanent Pastures and Other Grazing Land	6684	2
6	Land Under Miscellaneous Tree Crops and Grass not included in Nett Area Sown	3854	1
7	Current Fallows	28375	8
8	Other Fallow Land	9143	3
9	Nett Area Sown	176544	53
10	Geographical Area According to Village Papers	**336335**	**100**
11	Total Cropped Area	205689	
12	Area sown more than once	29145	

The details of land use pattern for the year 2006-07 is furnished in Table 3. As per the revenue land records, the total geographical area of the district is 0.33 Million hectares. For the year 2006 – 07, the net area sown is 0.17 Million Ha which is 53% of the total geographical area of the district. Forest area accounts for 13% of the total area. Barren and uncultivable land comes to 7%. Land put to non agricultural uses are 12%. Permanent pastures and other grazing land worked out to 2%. Land under miscellaneous tree crops accounts to 1%. The current fallows and other fallow lands are 8% and 3% respectively.

❖ Soil Classification:

Almost all soil types are seen in the district**.** Red loam and black soils are the predominant soil types in this district accounting for 59.3 % and 11.9 %, respectively followed by sandy alluvium in 4.84 %. About 1.92 % of the total land is suffering from salinity / alkalinity and soil prone to gullied, ravenous land accounting for 0.95 % and 0.97 % of the total land, respectively. The soil types and the place of occurrence are furnished in Table 10.

Table -10: Soil Classification

Sl.No.	Type of Soil	Places in District
1	Red Loam	Namakkal, Elachipalayam, Puduchatram, Mallasamudram, Rasipuram, Tiruchengode, Paramathi & Parts of Palliplalayam
2	Lateritic Soil	Kollihills
3	Black Soil	Erumapatti, Kabilaramalai, Mohanur, Namagiripet & Parts of Pallipalayam
4	Red Sandy Soil	Puduchatram
5	Sandy Coastal Alluviam	Kabilarmalai
6	Clay Loam	Sendamangalam,Vennandur, Erumapatti

❖ **Cropping Pattern:**

In general, Oilseeds constitute 27 percent, millets 19 %, Fruits and vegetables (including Tapioca) 17 percent, Pulses 16 percent and Rice 11 percent of the gross cropped area. The other major crops in this district are Sugarcane, Cotton and Turmeric. The Normal cropping pattern is given below:

Table -11: Cropping Pattern

Wet land:

Sl. No.	Crop	Month of Sowing
I	**Single Crop Sequence** :	
	Sugarcane	December - January
	Betalvine	June - July
	Banana	January - February
II	**Double Crop Sequence** :	
	Paddy	July - August
	Gingely	February

Garden land:

Sl. No.	Crop	Month of Sowing
I	**Single crop sequence :**	
	Tapioca	December
	Sugarcane	January - February
II	**Double Crop Sequence** :	
	Paddy	August - September
	Cholam (or) Groundnut	February
	Cholam (or) Cotton	
	Cholam (or) Pulses	
	Cholam (or) Gingely	

Dry land:

Sl.No.	Crop	Month of Sowing
I	a. Groundnut	May - June
	b. Fodder cholam (or) Sunflower	August - September
II	a. Groundnut	May - June
	b. Pulses	August - September
III	a. Groundnut (or) Cholam	June
	b. Horse Gram	October

❖ **Irrigation:**

The net area irrigated in this district in 2005-06 was 74,318 ha as against the net area sown of 176,544 ha which forms 42.5 % of the total area. The famous Cauvery River flows along the western and southern boundaries of the district. It benefits most of the cultivated lands in Pallipalayam, Tiruchengode, Kabilarmalai, Paramathi and Mohanur blocks through Mettur canal, Raja vaikkal, Mohanur vaikkal and Kumarapalayam vaikkal. River Thirumanimuthar starts from Yercaud hills of Salem district and flows through Namakkal district starting from Minnakkal village of Vennandur block and ends in the Cauvery River via, Nanjay Idayar village of Paramathi Taluk. Sixteen numbers of anaicut are there across the river and 18 numbers of tanks are fed by these anaicuts.

The well irrigation is the main source of irrigation covering nearly 70% of the irrigated area of the district from 81110 open wells and 8190 Tube wells. Tank irrigation is another source of irrigation covering 6% of the total irrigated area of the district through 259 irrigation tanks spread over the district. Table 12 below shows the source wise area irrigation for the year 2006 – 07.

Table 12: Source wise area under irrigation for the year 2006 – 07

Sl.No	Source	Number	Net Area Irrigated	%
1	**Surface Water**			
	1. Canals			
	i. Government Canals	3	6147	8.3%
	2. Tanks			
	i. Large	67	-	-
	ii. Small	192	4198	5.6%
	3. Other Sources			
	i. Flow Irrigation	-	6127	8.2%
II.	**Ground water**			
	1. Private Tube Wells	8190	6745	9%
	2. Open wells with pump sets	81110	51101	68.8%
	Total		**74318**	

❖ **Ground Water Potential**

Development of ground water in the district is through dug wells, filter points, dug-cum-bore wells and bore wells. The Net Annual Ground Water availability, computed as per norms recommended by GEC 1997 is of the order of 493.51 M.Cum. The existing ground water draft for all uses in the district as on 31.12.2003 is of the order of 503.82 M.Cum. The balance ground water resources available, computed as the difference between net annual ground water available and the gross ground water draft including the allocation for domestic and industrial uses for the next 25 years has been computed as 69.048 M.Cum for the district as a whole as in January 2003.

The stage of ground water development in 2003, computed as the ratio of the net ground water draft to available ground water resources for irrigation is in excess of 100 percent in Erumaipatti, Namagiripet, Namakkal, Pallipalayam, Puduchatram, Rasipuram, Sendamangalam and Vennandur blocks and hence they have been classified as 'OVEREXPLOITED'. Mallasamudram and Paramathi blocks, in which the development of ground water is between 90 and 100 percent, have been categorised as 'CRITICAL', whereas Kabilarmalai, Mohanur and Tiruchengode blocks, where the development is between 70 and 90 percent fall under 'SEMI CRITICAL' category. The remaining blocks in the districts fall under 'SAFE' category. The irrigation potential created is in excess of utilisable irrigation potential in a major part of the district. Limited potential is available for development in Elachipalayam, Kabilarmalai, Kolli Hills, Mohanur and Tiruchengode blocks. **www. cgwb.gov.in/SECR/EXECUTIVE%20SUMMARY-Namakkal%20.htm** (Central Ground Water Board, 2004)

Ground water in the district, in general, is potable both in the phreatic and deeper fractured aquifers. Incidence of high TDS, Fluoride and Nitrate has been reported from parts of the district. Ground water in a major part of the district is likely to cause high to very high salinity hazard when used for irrigation. The major ground water-related problems in the district include decline in ground water levels and the incidence of fluoride in excess of permissible limits in

parts of the district. Ground water potential of the district is very poor. Most of the blocks come under category of Dark and Gray. Kolli Hills and Tiruchengode blocks are classified as White category.

❖ **Size of land holdings:**

There are around 150,000 land holdings in the district occupying 85 % of the total area. Most of the land holdings are marginal and small. The percentage of marginal and small holdings is 55 % and 25 %, respectively. There are not much larger holdings in the district.

❖ **Area Under Principal Crops Cultivated:**

Principal crops cultivated in Namakkal district are Paddy, Sorghum, Groundnut, Tapioca, Sugarcane, Pulses, Cotton and Onion. The area and production of principal crops for the year 2005-06 is furnished in Table 13.

Most of the rice growing area is along the course of the Cauvery River. Sorghum is the major crop under rainfed in this district. It is cultivated both for grain and fodder Principal crops cultivated in Namakkal district are Paddy, Sorghum, Groundnut, Tapioca, Sugarcane, Pulses, Cotton and Onion. The area and production of principal crops for the year 2005-06 is furnished in Table -13. Most of the rice growing area is along the course of the Cauvery River. Sorghum is the major crop under rainfed in this district. It is cultivated both for grain and fodder purpose. Groundnut and Castor strip cropping under rainfed condition is a characteristic feature in Tiruchengode taluk. Tapioca is cultivated in almost all over the districts both under irrigated and rainfed conditions. There are more than 100 sago factories in this district. Tapioca is cultivated for industrial purpose in this district. Only starch rich varieties are cultivated. The productivity of this crop is 48 t / ha which is the highest in the country compared to the average of 28 t / ha.

Table -13: Area and production of principal crops for the year 2005-06

Sl.No.	Name of the crop	Area cultivated (in Ha)	Production in MT
		05-06	**05-06**
1	Paddy	18832	68849
2	Sorghum	29907	28940
3	Groundnut	47639	75317
4	Cotton	3140	7789 bales
5	Sugarcane	13278	1845642
6	Tapioca	22325	1076489
7	Onion	2707	31850
8	Turmeric	2115	12941
9	Pulses	7038	4863
10	Maize	2239	2284
	TOTAL	**149,220**	

Source : District Rural Development Agency, Namakkal

❖ Growth Trends in Agriculture / Farming Sector

Cereals, pulses and oilseeds are the three important categories of crops produced in the district. The data indicates that the productivity of cereals, oilseeds and pulses have fluctuated over the last 10 years. There is a reduction in the area of Rice, Millets, Pulses and Oilseeds. But, there is a steady increase in the area of Sugarcane and Cotton (especially due to the introduction of high yielding BT cotton hybrids). Similarly the area under fruits and vegetables witnessed an increasing trend.

Table -14: Area under crops over years (Lakh ha)

No.	Crop	1997	1998	1999	2000	2001-05*	2004-05	2005-06	2006-07	2007-08
1	**Rice**	**0.25**	**0.24**	**0.25**	**0.22**	**0.13**	**0.09**	**0.19**	**0.27**	**0.21**
2	Sorghum	0.19	0.21	0.10	0.09	0.22	0.25	0.30	-	-
3	Maize	0.01	0.01	0.01	0.01	0.01	0.02	0.02	-	-
4	Tapioca	NA	NA	NA	NA	NA	NA	0.22	-	-
5	Other millets	0.06	0.05	0.04	0.04	0.02	-	0.01	-	-
	Total Millets	**0.26**	**0.27**	**0.15**	**0.14**	**0.25**	**0.27**	**0.55**	**1.11**	**1.20**
5	Red gram	0.09	0.09	0.08	0.10	-	0.01	0.01	-	-
6	Black gram	0,08	0.09	0.09	0.10	-	0.04	0.01	-	-
7	Green gram	006	0.06	0.07	0.08	-	0.09	0.04	-	-
8	Other Pulses	0.08	0.08	0.10	0.10	-	0.04	0.01	-	-
	Total Pulses	**0.32**	**0.32**	**0.34**	**0.38**	**0.20**	**0.18**	**0.07**	**0.24**	**0.19**
	Total Food grain	**0.83**	**0.83**	**0.75**	**0.74**	**0.58**	**0.54**	**0.59**	**1.62**	**1.60**
9	Groundnut	0.80	0.76	0.68	0.73	0.50	0.48	0.48	-	-
10	Castor	0.12	0.11	0.10	0.13	0.02	0.03	0.03	-	-
11	Other Oilseeds	0.07	0.06	0.04	0.03	0.07	0.04	0.03	-	-
	Total Oil Seeds	**0.99**	**0.93**	**0.82**	**0.89**	**0.59**	**0.55**	**0.54**	**0.55**	**0.48**
12	Cotton	0.03	0.04	0.02	0.03	0.03	0.04	0.03	0.07	0.03
13	Sugar Cane	0.09	0.09	0.10	0.10	0.11	0.10	0.13	0.19	0.17
	Total	**1.93**	**1.89**	**1.69**	**1.76**	**1.31**	**1.23**	**1.54**	**2.43**	**2.28**
	Vegetables	-	-	-	-	-	0.21	0.26	0.29	NA
	Fruits	-	-	-	-	-	0.04	0.05	0.06	NA

Source : Department of Agriculture, Namakkal

Table -15: Production of crops over years (lakh tonnes)

No.	Crop	1997	1998	1999	2000	2001-05*	2005-06	2006-07	2007-08
1	Rice	0.95	0.99	1.2	1.09	0.51	0.69	1.03	1.13
2	Total Millets	0.34	0.32	0.29	0.22	0.25	0.33	1.37	0.80
3	Total Pulses	0.2	0.16	0.23	0.26	0.12	0.05	0.23	0.17
4	Total Oilseeds	1.33	1.31	1.39	1.38	0.74	0.76	1.04	1.26
5	Cotton	0.05	0.08	0.06	0.06	0.06	0.11	0.11	NA
6	Sugarcane	0.80	1.36	1.32	1.66	1.59	1.84	3.20	2.43

Table 16. Productivity of crops over years (kg / ha)

No.	Crop	1997	1998	1999	2000	2001-05*	2005-06	2006-07	2007-08
1	Rice	3751	4134	4888	4812	3848	3656	4773	
2	Total Millets	1339	1148	1933	1571	1002	988	1231	
3	Total Pulses	645	500	676	684	611	691	931	
4	Total Oilseeds	1348	1417	1695	1541	1250	1472	1887	
5	Cotton	285	383	441	318	-	422	2.64	
6	Sugarcane	86.6	144.5	138.0	161.8	143.1	138.9	166.1	

***** Average of five years from 2001 to 2005

Upto 2005, the trend in the production was negative. There was a declining trend in production mainly due to reduction in the area cultivated in crops like Rice, Millets, Pulses and Oilseeds. But the production of Cotton almost doubled (200 %) when compared to 1995. The Sugarcane production increased from 0.08 lakh tonnes from 1997 to 3.2 lakh tonnes in 2006-07 achieving fourfold increase in production.

Regarding productivity of crops also, there is an increase in the productivity from 2005 onwards which could be due to the cultivation of high yielding varieties of crops and hybrids.

With the optimism generated by new technologies, the district set for itself the goal of achieving an annual growth rate of 4.5 % in agriculture in the Ninth Plan period. With appropriate policies, programmes and strategies, the district registered an annual growth of 6.21 %. However, the performance of agricultural sector showed a negative growth of 5.8 % during 1999-2000 due to vagaries of monsoon and as a result, the agriculture and allied activities could register an annual growth of only 2.72 % during the Ninth Plan period. Widespread adoption of seed-fertiliser - water technology has helped in generating additional output, income and employment.

The total milk production in this district is 2.68 lakh tonnes per annum. Meat production is also fairly high. Annually 398 crore eggs are produced which is around 60 % of the states egg production. The livestock sector in this district is growing at 4 % growth rate while poultry is growing at around 10 %.

With the present growth rate and taking into consideration the growing demand for poultry feed ingredients especially Maize, the growth in agriculture sector is predicted to be around 6 % and the prospect for agriculture seems to be good.

D.3 ANIMAL HUSBANDARY:

Animal husbandry contributes significantly in supplementing the income of small, marginal farmers and landless labourers and in generating gainful employment opportunities especially self-employment to a substantial number of rural and urban population. It serves as a vital source for providing nutritious protein rich balanced food in the form of milk, egg, meat and value added products. Moreover, they are also intricately associated with the social, cultural and traditional values of this district.

As per the 17th Quinquinnial Livestock census the total cattle population of the district is 0.39 Million, sheep 0.14 Million and goat 0.37 Million. Nearly 600 poultry farms are functioning in this district having nearly 20 Million birds producing 10 Million eggs per day. Since it produces major share of eggs in the state and sent to all over the country and also, outside the country, Namakkal is called 'Egg city'. Nearly one lakh people are getting employment directly and indirectly from this poultry farms.

There is no coastal area for marine fishing. Through inland fishing, a quantity of 509 T of fish is caught every year. The major source of fishing are the river Cauvery, canals, seasonal tanks and ponds.

LIVESTOCK POPULATION

YEAR:2006-2007

Sl.No	Classification	Numbers
(1)	(2)	(3)
	Cattle	
	1.Male	
	i.Under one year	108527
	ii. one to 2.5 years	217054
	iii.Over 2.5 years	211809
	2.Female	
	i.Under one year	94184
	ii. one to 2.5 years	65080
	iii.Over 2.5 years	128273
	a. In milk	86196
	b. Dry	8274
	c. Not Calved even once	381957
	Total	763964
	Cattle Total	396064
	3.Sheep	140233
	4. Goats	378885
	5. Horses and Ponies	922
	6.. Pigs	21634
	7. Mules	73558
	8.Camels	-
	9.Donkeys	490
	10.Domestic Dogs	850
	Total Livestock	907551

MILK SOCIETIES

YEAR : 2006-2007

Name of the District	Number of milk societies	Quantity of milk produced (In Lakh) Liters	Value of milk product (In Lakhs)Rs.
(1)	(2)	(3)	(4)
Namakkal	469	1,42,211	15,04,592

Source: Deputy Registrar (Dairy) Namakkal.

POULTRY FARMS

YEAR : 2006-2007

Name of the Taluk	No.of Forms	No.of Birds	Total No of Eggs produced per day	No. of Person Employed
1.Namakkal	310	12522030	6636676	62610
2.Rasipuram	110	2700790	1431419	13504
3.Paramathi-Velur	48	1435816	760982	7179
4.Tiruchencode	120	2796690	1482246	13983
Total	588	19455327	915000	97276

Source: District Poultry Development Office.

E.0 TREND IN USE OF FERTILIZER (ORGANIC AND INORGANIC)

E.1 Potential Availability of Organic Manure

The total cropped area of the district is 0.20 Million ha. If the manure requirement is calculated at 12.5 t / ha, the total requirement / annum will be 2.5 Million tonnes. The estimated availability of organic manure is given in Table-17. The total quantity available in 2006 was 2.20 Million lakh tonnes. About 20 % of the manure is used for purposes other than agriculture like biogas, fuel, fish feed etc., Remaining quantity is essentially used in agriculture. Even though there is a decrease in the availability of organic manure like FYM, goat and sheep manure over the years, there is an increase in the total quantity due to enormous increase in the availability of poultry manure. But about 60 % of the poultry manure is not used in the district. It is learnt that the manure is sold outside and is transported to Kerala for use in plantation crops.

Table - 17. Estimated availability of organic manure (lakh tonnes)

Sl No	Animal type	Quantity produced @	2002		2004		2006	
			Populn lakhs	Manure avail	Populn lakhs	Manure avail	Populn lakhs	Manure avail
1	Cattle	10kg/day/ animal	4.14	15.10	4. 05	14.77	3. 96	14.46
2	sheep	0.5kg/day/ animal	1.48	0.54	1. 46	0.53	1. 40	0.51
3	Goat	0.5kg/day/ animal	3.99	1.46	3. 89	1.42	3. 79	1.38
4	Poultry	25kg/year / bird	129.6	3.24	192.8	4.82	256.5	6.41
			Total	**20.34**		**21.543**		**22.77**

Over the past two and a half decades, farmers have become increasingly dependent on chemical sources of nutrients for obtaining higher grain yields to meet the demands of enlarging population. The use of green manure crops, animal manures and composts which traditionally were important sources of nutrients, declined substantially as chemical fertilizers became increasingly available. The price of chemical fertilizers was subsidized, thereby enabling farmers to apply maximizing doses.

Use of organic materials to build up soil fertility is an age-old practice in India. The continuous addition of organic materials with or without mineral fertilizers will help to maintain the soil organic matter at a reasonable level. Such materials rarely supply sufficient nutrients to produce moderate to high yields. Organic manures not only supply nutrients but they also improve soil physical and chemical properties.

E.2 Potential Availability of Crop Residues

Crop residues are the plant parts remaining in a field after the harvest of a crop, which include stalks, stems, leaves, roots, and weeds. Agricultural crop residues include corn stover (stalks and leaves), sorghum straw, rice straw and processing residues such as nut hulls.

The estimated availability of crop residues in the district is given in the Table 18. The trend shows a decline in the availability of crop residues over the years mainly due to reduction in area and production of rice, millets, pulses and oilseeds. Even though there is an increase in area and production of sugarcane, it does not contribute as the residue from sugarcane is less. Out of the total quantity, 50 % is normally used as dry fodder for livestock especially paddy straw, sorghum straw, ground nut haulms etc., and the remaining residues are available for utilization in agriculture.

Table-18. Estimated availability of crop residues in lakh tonnes

No	Crop	1997		1998		1999		2000		2006	
		Prod	CR	Prod	CR	Prod	CR	Prod	CR	Prod	CR
1	Rice	0.95	1.43	0.99	1.49	1.20	1.80	1.09	1.64	.69	1.03
2	Total Millets	0.34	.52	0.32	0.48	0.29	0.44	0.22	0.33	.33	0.49
3	Total Pulses	0.20	0.30	0.16	0.24	0.23	0.35	0.26	0.39	.05	0.07
4	Total Oil Seeds	1.33	2.00	1.314	1.97	1.39	2.09	1.38	2.06	.88	1.33
5	Sugar Cane	0.80	0.16	1.36	0.27	1.32	0.26	1.66	0.33	1.84	0.37
	Total		**4.40**		**4.45**		**4.92**		**4.75**		**3.29**
	50 %		**2.20**		**2.22**		**2.46**		**2.38**		**1.65**

The total quantity of organic manure available is 1.82 + 0.16 = 1.98 Million tonnes. But the requirement is estimated to be 2.57 Million tonnes. There is a deficit of 22.7 % in organic manure. Moreover 60 % of poultry manure is reported to be transported to Kerala and hence, still the deficit increases. So, the potential for the use of organic manure is high. In many places unavailability of organic manure is often quoted as the reason for non application of organic manure in the district.

E.3 Fertilizer Consumption

The inorganic fertilizer consumption pattern over years is given in Table -19. It is evident that 26824 MT of chemical fertilizers were used in 2005-06 out of which about 50 % fertilizer is Nitrogenous fertilizers. P fertilizer is the least consumed fertilizer. There is a steady increase in fertilizer consumption over years from 14509 MT in 2001-02 to 26284 MT in 2005-06 at a growth rate of 24 % per annum. This is mainly because of the adoption of high yielding varieties and improved agricultural practices. This clearly shows that the farmers have been dependant on chemical source of nutrients for observing higher yields.

Table -19: Year wise Fertilizer Consumption

Year	Nutrients			Total
	N	P	K	
2001-02	7340	3850	5525	14509
2002-03	6294	2696	2697	11957
2003-04	8265	3865	3972	16102
2004-05	9774	5235	5806	20815
2005-06	13120	6139	7570	26824
2006-07	11322	5650	6280	23252

E.4 Pesticide Consumption

Table – 20: Year Wise Pesticide Consumption

Year	Pesticide	
	Dust (mt)	Liquid (lits)
2001-02	30.950	15080
2002-03	73.500	6360
2003-04	135.650	11175
2004-05	103.942	16559
2005-06	189.073	17122

Regarding the pesticide consumption also, there is a tremendous increase in the consumption over years especially the dust form. There is six fold increases in the consumption of dust form and 12 % increase in the consumption of liquids. This trend is attributed to the cultivation of high yielding varieties of crops in place of traditional varieties.

F.0 INITIATIVES IN ORGANIC FARMING

In order to switch over from the usage of chemical inputs that are hazardous to human health, awareness is being created among the farming community to use organic inputs viz., neem based products, vermi-compost and bio-fertilizers like azospirillum, phosphobacteria etc. by various organizations.

F.1 Government Initiatives:

Organic farming in the district is in an infant stage. The government department of Agriculture has just initiated the activities related to organic farming. The state Department of Agriculture, along with the centre, under the National Programme for Organic Farming has covered 12 districts including Namakkal wherein some participants underwent a five day training from March 6. Subsequently another training, including certification agencies, NGOs, service producers, leading organic farmers participated in a ten day programme from march-21. In the district level, training is being given to the farmers on vermin composting technology, preparation of enriched FYM etc. More emphasis is given for the use of biofertlizer, biological control using *Trichogramma viridi.*

Similarly training is given to farmers under the project IAMWAM on organic farming. It is planned to take up organic cultivation of specific crops under the concept organic farming by the Tamil Nadu Agricultural University under the same project.

The Department of Agriculture is also rendering the following services indirectly towards the promotion of organic farming through the following institutes.

Sugarcane Parasite Breeding Station – Mohanur: Sugarcane Parasite Breeding Station is located at Mohanur where Salem Co-operative Sugar Mill is located. In this Station, Sugarcane egg parasites of *Trichogramma chilonis* are produced for the control of Sugarcane internode borer. The egg parasites are supplied to the farmers through Agricultural Extension Centre or directly to the farmers.

Coconut Parasite Breeding Station – Velur: Coconut Parasite Breeding Centre is located in Paramathi Taluk. The main objective is to control coconut black headed caterpillar – *Opising arenogella* as biological method of control by releasing of egg parasite namely Braconids - *Bracon breulcornis*. Every year about 5,00,000 *Broconids* are produced and released in 500 ha of coconut fields in Namakkal District.

Bio Control Lab – Namakkal: Bio control lab is functioning at Namakkal Panchayat Union near Namakkal Agricultural Extension Centre. It is programmed to produce 1000 Kgs. of *Trichoderma Viridi*, 2000 Kg. *Pseudomonas fluorescense* and 200 Ltrs. of NPVs.

More over, agricultural inputs like seeds, bio-fertilisers and bio-pesticides are being marketed and distributed through Agricultural Extension Centres.

Some new schemes are to be implemented by the Government of Tamil Nadu for promoting organic farming at an outlay of Rs. 28.2 Million.

a) Scheme on bio-fertilizer distribution under 50% subsidy: It is proposed to distribute the bio fertilizers through Agricultural Extension Centres for better crop yield. At present, bio-fertilizers are produced in the State owned bio-fertilizer laboratories and distributed to the

farmers. 10 % are sold under 50 % subsidized rate under schemes available through department such as NPDP, OPP and ICDP. Remaining 90% of the stock is sold at full rate.

b) Scheme on composting of farm waste through *Pleurotus* (Rs. 1.2 Million): The scheme attempts to quicken the process of composting and also to compost with better composition of farm waste with the help of *Pleurotus species*. To popularise this technology, it is proposed to supply the farmers with one kg of *pluerotus* with 5 kgs of urea along with a booklet as kit. Each kit worth Rs. 120/- will be supplied to 10,000 farmers at a cost of Rs. 12 lakhs.

c) Vermi composting of agricultural wastes (Rs. 1.60 Million): To popularize the technology of Vermi composting, it is proposed to conduct demonstration in 500 centres in the State. Besides, at the rate of 50 farmers per centre (50 500) i.e. 25000 farmers will be trained in Vermi composting technology. To popularize this technology among other farmers, necessary awareness has to be created. This scheme will be implemented in all districts except Nilgiris district in the State during the Tenth Five Year Plan period at total cost of Rs. 16 lakhs.

d) Green Manure Scheme (Rs. 19.40 Million): Application of Green Manure is one of the practices recommended for increasing soil health, soil structure and water holding capacity of the soil and facilitate better drainage and releases locked up nutrients besides improving soils status in the long run at a cheaper cost. Green Manure seed farms will be raised in selected holdings of farmers, state seed farms and state oilseed farms and distribute to the farmers at 25% subsidy through Agricultural Extension Centres of the Department of Agriculture at a cost of Rs. 1.94 crores.

F.2 Initiatives by NGO's:

There are around 19 registered NGOs in Namakkal district**.** Out of them only a few NGOs have taken iniatives in organic farming. M/S kandasamy Kandar Environmental Organization is giving training on solid waste management for efficient recycling of organic wastes. Akhil Dr. B. R. Ambedkar Trust of Erumappatty block has initiated training in vermicomposting. The Tamil Nadu Organic farmers Technology Association led by S.R. Sunderaraman organized series of small training workshops to introduce chemical farmers to organic methods. The training at Namakkal was initiated and conducted from 7-8 May 2005. Tribal welfare Association, Kolli Hills and Lamp (Tribal Welfare Co-operative Society) of Kolli hills are taking efforts for such initiatives.

F.3 Promotion of organic farming by MS Swaminathan Research Foundation:

M / S MS Swaminathan Research Foundation at Namakkal is taking up the venture of promotion of organic cultivation of pine apple, minor millets and also spices. The primary occupation in Kolli Hills is agriculture. Cultivation is mostly through natural farming with farmyard manure (FYM) inputs and family labor using local landraces of Samai, Thinai, Varagu, Panivaragu and Upland paddy. Fruit yielding crops like Banana, Guava, Pomegranate and Jack are grown in the backyards of houses and farms. Crops like Tapioca, Pepper, Cardamom and Coffee are also cultivated as cash crops.

Case study of successful organic pine apple cultivation in Kolli hills:

A study on the scenario of pineapple export and the impact on the farmers was carried out by MSSRF. Data collection, mapping and compilation of data on fruits like pineapple and guava and crops like millets and pepper, have been carried out by MSSRF for organic certification.

Ecocert has certified the organic nursery, and the organic pineapple cultivating farmers received NOP (National Organic Programme, USA) certificates. In addition, about 35 ha of fallow land has been put under organic pineapple farming, with a financial subsidy of Rs 5 lakhs from DRDA, Namakkal.

In the Kolli hills, five villages with a large area under pineapple production were identified. The pineapple farmers were mobilized into self-help groups (three women, one man and one mixed groups). Their capacity to negotiate was developed through group discussions and training programmes with external agencies. MSSRF brought together the pineapple farmers and the Ion Exchange Enviro-Farms Pvt Ltd (IEEFL), a Pune-based organic export company. ECOCERT International, a Germany-based organic certifying agency, was approached for certification. A group of multidisciplinary experts inspected the site and certified the entire area as an organic production zone for pineapple cultivation (232 acres). Men and women members of the self-help groups pooled the produce coming from the various localities to ensure quality while marketing it at the collection centers. The process instilled a feeling of collective ownership and enhanced the business skills of the self-help members. The collection was done under the supervision of IEEFL. Nearly 40 tonnes have been marketed, out of an estimated potential of 400 tonnes. The increase in profit through organic marketing is estimated at about 40 percent.

Self help groups are periodically trained by the Scientists of CFTRI and Kuringi Organic Farms from Kodaikanal on organic cultivation methods and export packing. These groups have been involved in this venture for the last three years. The export quantity has increased from 20 to 100 tonnes in the last two years. This organic produce export venture has created confidence among SHGs. This effort not only promotes stable household income, but also reduces drudgery. Farmers are also safe from losses on account of fluctuating market demands and from exploitation by middlemen.

The case study highlighted the effectiveness of the SHGs in procuring pineapple for export, and pointed out to some of the emerging requirements, like the effective adoption of organic agricultural techniques, documentation, demonstration and internal control mechanisms (MSSRF, 2003).

SHG members of Kolli Hills and Namakkal were taken on an exposure trip to Krisna Vermibio unit at Namakkal. Organic farming training with DRDA and IEEF was organised for the organic pineapple growers. 133 tons of organic pineapples worth Rs 6.65 lakhs were exported to the USA through IEEF. SHGs supplying organic pineapple received an incentive of Rs 66,000 to get the organic product-marketing certificate from ECOCERT. Two SHGs in Thirupulinadu were facilitated to receive Rs 2.5 lakhs for organic pineapple cultivation through Indian Bank.

F.4 Organic farming by individual farmers:

A few farmers and organizations are practicing organic farming but not to the extent of obtaining certificates. They are producing and selling their produces locally. There are no exporters of organic produce in this district. These farmers are also distributed randomly in the district. There are no certified organic farms and there is no registration for crops for organic certification. However, a list of farmers practicing organic farming is given in the Table - 21.

Table -21: List of farmers practicing organic farming

Sl. No	Name of the Farmer	Address	Crop Name	Area	Irrigated /Rainfed	Certified or not
1	Centre for Health and Education Alternative Development Service	M.S.A. Sathishbabu, Opp. to Sugarmills Mohanur Namakkal-637015	Cholam, Groundnut, Banana	2.75 Acres	Irrigated	No
2	Rural Training Centre (HEALDS)	M.S.A. Sathisbabu, Opp. To Sugar mills Mohanur Namakkal 637 015	Cholam, Groundnut, Banana	10 acres	Irrigated	No
3	V. Rajasekaran	Santhi Nilayam, Pilikkalpalayam Jedarpalayam via, Paramathivelur Namakkal-637213	Sugarcane, Paddy	15 Acres	Irrigated	No
4	R. Thangamani	36, Paaraiyar Ayyampalayam Kumarapalayam Trichengode,Namakkal-638183	Paddy, Gingeely, Sugarcane	10 acres	Irrigated	No

F.5 Demand for Organically Grown Food

Several buyers have shown interest in purchasing organic farming products, especially traditional millets. Pineapple farmers have earned Rs 15.5 lakhs during the year 2003-2004 and the self help group (SHG) involved in organic pineapple export has earned Rs 1.15 lakhs.. The demand for organically produced spices and other food products is growing rapidly. Food trends are changing with the increasing health concern. As organic foods & spices are free from chemical contaminants, the demand for these products is increasing. Since spices form part of many medicines, the demand for organically produced spices is also increasing.

The International Life and Food Association, a Japan-based NGO working primarily to revive the millet diet in Japan, is negotiating with the self-help groups of the Kolli hills to procure minor millet. Local networks like Reliance Fresh, Food World, Wallmart, Amudham etc., of the neighboring districts are purchasing organic produces.

F.6 Organic Feedstock for Livestock / Poultry:

The first step in organic livestock production is the organic fodder production. Feed is strictly regulated and no genetically modified, urea or solvent-based products are used. Apart from changes in forage production, changing to organic management for the dairy herd involves changes in the diet. The proportion of concentrates in the total ration is restricted to 40% and, if certification of the milk is envisaged, the dairy herd can only be fed a concentrate mix made up from acceptable ingredients, such as cereals and grain legumes, preferably from organic origin. Up to 20% of the ration may consist of conventional ingredients from a limited range of

components, such as maize gluten, soya and linseed cake. At present even though the demand for organic fodder and feed for livestock is negligible, the demand for the same is expected to increase many times in near future as the demand for organic milk and
meat is slowly increasing for export purposes.

Poultry population is increasing year by year and the industry is growing at an annual growth rate of 10 % and with this growth the requirement for millets especially maize for poultry feed is increasing. Organic eggs are being marketed to foreign countries and for production of organic eggs, millets produced organically are required. Hence there is a great scope for organic millets as feed for poultry for production of organic eggs for export of both eggs and egg powder.

G.0 POULTRY LITTER USE AS ORGANIC FERTILIZER

Poultry population is raising every year leaving large amount of poultry refuse. The poultry population is estimated to be 20 million and the manure availability is estimated to be 0.6 m million tonnes in Namakkal district of Tamil Nadu. The poultry population is not spread throughout, but is concentrated in some pockets only. So, disposal of the manure as soon as the same is removed from the poultry house is a problem because of the high cost of transport to distant places. Hence, the manure is stored in most of the farms before disposal, at least for a period of one month and this leads to loss of nearly 40% N which reduces the value of the manure.

Land application of Poultry manure for crops has been the traditionally and still the most important use. But, modern methods of rearing poultry have complicated the problem. Much of the manure now produced contains no litter. Litter is not used when birds are used in cages or slots. When poultry litter is used it absorbs moisture and helps keep the manure friable so a large surface area is exposed to the air. Manure free litter on the other hand contains 70-80% moisture making the process of application difficult. At the same time, if stored to reduce the moisture content, nutrient losses occur and handling cost increases. Another problem peculiar to this manure is that the N is too quickly available so that, if care is not taken in applying it, burning occurs.

Hence, for quick disposal to avoid loss of nutrients and to avoid environmental pollution, the manure can be recycled principally in the following ways.

1. Energy generation
2. Land application as plant nutrients to crops,

G.1 Types of Poultry Litter

Deep litter

This refers to the manure produced by layers during the laying period. Deep litter for laying hens usually consists of peanut hulls, rice husk or wood shavings in a layer of 10-15 cm deep. During production, the accumulating manure gets mixed with the litter. When excreta are added, the litter becomes moist but remains aerobic. Aerobic fermentation occurs with the production of heat and loss of CO2 and ammonia.

Broiler House Litter

This manure is similar to deep litter poultry manure but the litter is changed more frequently and there is less ammonia loss because of restricted decomposition. This results in manure richer in N than deep litter manure.

Cage Litter

This manure contains 70-80% moisture since it is not mixed with litter materials. Enormous loss of ammonia occurs in this manure if it is not used the earliest. Litter is not used when birds are used in cages or slots.

G.2 Nutrient content

Nutrient values of poultry manure vary considerably depending upon the conditions under which it is processed. The ratio of litter to manure and the moisture content causes considerable variation among manures from different houses. In fresh poultry excreta, uric acid or urate is the most abundant nitrogen compound (40-70 per cent of total N) while, urea and ammonium are present in small quantities.

Table - 22: Nutrient content of different types of Poultry manure

S.No.	Particulars	Deep Litter	Broiler House	Cage Manure
1	C/N Ratio	9.5-11.5	9.4-11.2	5.8-7.6
2	Total N (%)	1.70-2.20	2.40-3.60	3.63-5.30
3	Total P_2O_5 (%)	1.41-1.81	1.56-2.80	1.54-2.90
4	Total K_2O (%)	0.93-1.30	1.40-2.31	2.5-2.90
5	Fe (Ppm)	930-1380	970-1370	970-1450
6	Zn (Ppm)	90-308	160-315	290-460
7	Cu (Ppm)	24-42	27-47	80-172
8	Mn (Ppm)	210-380	190-350	370-590
9	Ca (%)	0.90-1.10	0.86-1.11	0.80-1.02
10	Mg (%)	0.45-0.68	0.42-0.65	0.40-0.56

G.3 Issues related to storage & handling

- ✓ Ammonia Emission
- ✓ Nitrate Pollution
- ✓ Surface water contamination
- ✓ Under groundwater contamination

- ✓ Fly attraction and breeding
- ✓ Public nuisance

The nutritional value of unprocessed poultry manure deteriorates rapidly. Poultry manure containing moisture, when stored in open air, rapidly lose its N due to high proteolytic activity. Hence, immediate processing of poultry manure is suggested to prevent rapid decomposition.

Fresh poultry manure is difficult to handle because of its high water content and quick nitrogen availability. Hence it cannot be applied to crops due to caustic effects on foliage.

Nitrogen in poultry litter is subject to volatilization, denitrification, immobilization, mineralization, leaching and plant uptake. Immobilization is responsible for reducing inorganic N shortly (1-2 weeks) following application of poultry waste. Mineralization occurs quite rapidly following application of poultry waste. Approximately 69 per cent of organic N in poultry litter incorporated into a sandy loam soil was mineralized in 140 days. Shortly following application, conditions generally favour volatilization of the ammoniacal - N.

G.4 Processing of Poultry Litter

Before field application immediate processing of poultry manure is needed to prevent rapid decomposition and loss of nutrients. There are several commonly practiced methods of storing poultry manure, each of which could affect the quality of the manure at the time of application. "Drying" improves the physical characteristics of the poultry manure while achieving acceptable N conservation. But, it is limited by cost and mechanical consideration. Similar work has been conducted regarding centrifugation and vacuum filtration. All these have proven successful, but the economic feasibility has not been conclusively established.

G.5 Composting poultry Litter

Composting, or the controlled biological decomposition of organic waste, has been investigated as a method of stabilising poultry manure prior to land application. This process produces a material with several advantages with respect to handling by reducing volume, mass of dry matter, odours, fly attraction and breeding and weed seed viability. Composting poultry manure and poultry carcasses, with straw as carbon source successfully decomposes the manure and carcasses and produces a stable organic material physically and chemically similar to the manure used in composting process.

G.6 Effect of application of poultry manure

Soil physical properties

Poultry manure application improves the physical properties of the Soil. It significantly decreases bulk density and increases total porosity, infiltration capacity and water holding capacity.

Nutrient availability

Poultry manure is a better source of all plant nutrients than other manures. It increases the available N, exchangeable K and decreases the adsorption capacity and increases the soluble P. Land applied poultry litter supplies nutrients necessary for crop growth, the most prevalent being nitrogen.

Nutrient uptake

Addition of poultry manure either alone or in combination with N, P and K increases the uptake of N, P and K in many crops. An increase in N, P, K, Fe, Mn and Cu contents in many crops due to the application of poultry manure in comparison with FYM has been reported by many scientists.

Yield of crops

Application of Poultry manure either alone or with FYM in conjunction with mineral fertilizers helps to increase the yields of many crops mainly due to the ability to supply all the nutrients required for crop growth.

Higher grain yields of rice by incorporation of farm wastes and green manures, with the highest yield by poultry manure was obtained under lowland conditions by Budhar *et al*. (1991) indicating the superiority of poultry manure. Savithri *et al*. (1991) reported that application of coir pith based poultry litter at 6.25 t ha-1 along with recommended levels of NPK registered highest yield of sorghum.

Giardini *et al*. (1992) reported an increased yield of onion bulbs due to poultry manure, which produced yields of more than 35 t ha-1. They have also reported that the highest yield of tomato and marketable yield of tomato due to combined application of poultry manure and mineral fertilizers.

Residual effects

Application of Poultry manure to the first crop has significant residual effect on succeeding crop yield and that also increases the nutrient content of the soil. Savithri *et al*. (1991) reported that application of 6.25 t ha-1poultry manure to the first crop of sorghum had significant residual effect on succeeding crop yield and that also increased the nutrient content of the soil.

Quality of crops

Abu Saleha (1992) observed an increase in the total carbohydrate, protein and ascorbic acid and a decrease in the crude fiber content in Okra due to the application of 10 kg N as ammonium sulphate + 50 kg N as poultry manure. Pimpini *et al*. (1992) observed the best results of processing suitability index in potato for production of both chips and sticks and higher total and extractable sucrose and a lesser extractable sucrose ratio in sugarbeet with 4 t ha-1 poultry manure. Mohamed Amanullah *et al.* (2007) reported an increase in the starch content and starch yield in Cassava due to application of composted poultry manure.

H.0 Summary:

- Agriculture continues to be the most predominant sector of the district, as 70% of the population is engaged in agriculture and allied activities for their livelihood.
- Livestock rearing and poultry farming are integral part of agriculture in the district.
- The district has a geographical area of 3.36 lakh ha with a gross cropped area of around 2.06 lakh ha with a cropping intensity of 1.2
- The area under irrigation is 42.0 % of the total cropped area and the irrigation intensity is 1.2.
- Principal crops cultivated in Namakkal district are Rice, Sorghum, Groundnut, Tapioca, Sugarcane, Pulses, Cotton and Onion
- The area under Cotton, Sugarcane and Millets especially Maize is fast increasing while the area under Pulses and Oilseeds is decreasing
- As almost the entire cropped area is covered by high yielding varieties of crops, consumption of inorganic fertilizers and pesticides is increasing year by year
- With the present growth rate and taking into consideration the growing demand for poultry feed ingredients especially Maize, the growth in agriculture sector is predicted to be around 4 % and the prospect for agriculture seems to be good.
- Organic manure available in the district is not sufficient to meet the requirement of the same for crops and similar is the case with the nearby districts also.
- Poultry industry is growing fast at an annual growth rate of 10 % which demands huge quantity of millets for feed and hence the area under millets is increasing.
- Initiatives for the promotion of organic farming is recently taken by the Department of Agriculture
- NGOs have also taken some initiatives in the same by providing training on solid waste management, vermicomposting etc.,
- MSSRF have taken efforts for organic cultivation, their certification and marketing of pine apple in Kolli hills.
- They are also promoting cultivation of minor millets under natural farming.
- Market demand for organic produce is slowly increasing as there is awareness among the public about the benefits of organic produces.
- There is a good scope for biogas power generation & organic manure in this area

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Fig 3. Poultry droppings from caged birds

Fig 4. Raw poultry manure

Fig 5. Adding straw and cow dung to poultry manure for composting

Fig 6. Pile of Composted Poultry Manure