Bio-energy based Integrated Agriculture Value Chain for Environment-friendly Sustainable Development of Tanzania

Proposed

By

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1. Introduction:

Tanzania is a country located in East Africa. It is bordered by Kenya to the northeast, Uganda to the north, Rwanda, Burundi, and the Democratic Republic of the Congo to the west, Zambia, Malawi, and Mozambique to the south, and the Indian Ocean to the east. The climate in Tanzania varies considerably due to its size and diverse geography. Agriculture and allied activities are the major source of livelihood here. Zone wise major traditional agriculture and horticulture activities are identified and it requires timely diversification with value chain approach, entrepreneurship and climate resilience building. All the agricultural and horticultural waste/ residues along-with other bio-degradable waste shall be used as raw materials to bio-energy industry. Finally, the farmer of Tanzania will become ANNA-DATA as well as URJA-DATA (i.e., Farmer as foods providers as well as energy providers). It means the famers shall become one of the prime movers of the country economy. The present proposal is focusing on agriculture diversification including millets, herbal and aromatic plants cultivation with efforts of climate resilience building. The agro-climatic zones can be broadly classified into four main climate zones:

1.1 Coastal Zone: This region, along the Indian Ocean, has a tropical climate characterized by high temperatures and high humidity. The temperatures range from 25°C (77°F) to 31°C (88°F) throughout the year. Rainfall is abundant and occurs mainly during two distinct periods: from March to May (the long rains) and from November to December (the short rains).

1.2 Eastern Plateau and Lake Victoria Basin: This area experiences a bimodal rainfall pattern, with the long rains occurring from March to May and the short rains from October to December. The temperatures range from 18°C (64°F) to 29°C (84°F) depending on the season and location.

1.3 Central Plateau: This region, which includes the capital city of Dodoma, has a semi-arid climate. Temperatures can range from 10°C (50°F) at night to 30°C (86°F) during the day. Rainfall is limited, and droughts can occur.

1.4 Northern Highland Zone: This area includes popular tourist destinations like Arusha and Kilimanjaro. It has a temperate climate with cooler temperatures, especially at higher elevations. Rainfall is more reliable, but it can still be seasonal.

2.Agro-Climatic Zone wise Crop Production:

Crop production and other agriculture & allied sector farm activities are solely dependent upon the agro-climatic conditions of the country. The coastal areas and

regions around Lake Victoria have more favorable conditions due to their relatively consistent rainfall and higher temperatures. The coastal region allows for the cultivation of tropical crops like coconuts, cashews, and spices, while areas around Lake Victoria are suitable for a variety of crops including maize, cassava, bananas and other horticultural crops.

The central plateau and northern highland zones, conditions can be more challenging due to the semi-arid climate, but with proper/protective irrigation such region is suitable for rain-fed agriculture like millets, herbal and aromatic crops etc. Date palm and olive may also be tried on pilot basis. Both these crops require minimal irrigation and may survive even on 46-48 Degree Centigrade Temperature.

It's important to note that climate conditions can vary year to year due to factors like El Niño and La Niña, so local knowledge and adaptive farming practices are crucial for successful crop production in Tanzania. Additionally, considering the impact of climate change, it's advisable for farmers to stay informed about evolving climate patterns and adapt their agricultural practices accordingly. Here-under are the different type of crops more suitable in Tanzania:

1. **Maize (Corn):** Maize is a staple food in Tanzania and is widely cultivated across the country. It is a major source of carbohydrates for the population.
2. **Rice:** Rice is an important staple crop, especially in regions with favorable conditions for its cultivation, such as areas around Lake Victoria and parts of the coastal region.
3. **Cassava:** Cassava is a drought-tolerant root crop that is a significant source of carbohydrates for many Tanzanians, especially in the drier central and southern regions.
4. **Bananas and Plantains:** These are important staple crops, particularly in the highland areas and regions with favorable conditions for their growth.
5. **Sorghum and Millet:** These are drought-tolerant cereal crops that are well-suited to the drier parts of Tanzania, including the central plateau.
6. **Beans:** Beans are a crucial source of protein in the Tanzanian diet and are grown in various regions across the country.
7. **Pulses:** Including crops like pigeon peas, lentils, and chickpeas, pulses are important for both domestic consumption and export.
8. **Coffee:** Tanzania is known for producing high-quality coffee, especially in regions like Kilimanjaro, Mbeya, and Arusha.

9. **Tea:** Tea is another important cash crop, primarily grown in regions like Iringa, Mbeya, and Mufindi.
10. **Cashew Nuts:** Tanzania is a significant producer of cashew nuts, with coastal areas and regions like Mtwara being major production centers.
11. **Sisal:** Sisal is a fiber crop that is mainly grown in the coastal regions and provides an important source of income.
12. **Horticultural Crops:** These include a wide range of fruits and vegetables like tomatoes, onions, mangoes, citrus fruits, and more. They are cultivated across the country.
13. **Spices:** Zanzibar, which is part of Tanzania, is famous for its spice production, including cloves, cinnamon, and nutmeg.

Along-with above crops, we may add Bamboo, Moringa, Lemongrass, Vetiver cultivation practices in Tanzania for environment-friendly sustainable development of the country economy as well as facilitate the employment and self-employment opportunities at the door steps of the farmers/ villagers. It's important to note that crop suitability can vary within Tanzania due to the diverse climate and soil conditions. Additionally, local knowledge, availability of resources, and market demand play significant roles in determining which crops are most suitable for a particular area. Farmers often adapt their choices based on these factors to optimize their yields and income.

3. Millets production in Tanzania:

In Tanzania, especially in regions with semi-arid or drought-prone conditions, millets can be a valuable crop due to their drought tolerance and ability to grow in less favorable conditions. The two main types of millets that are more suitable for production in Tanzania's climate are:

3.1 Pearl Millet (Pennisetum glaucum):

Suitability: Pearl millet is well-suited for semi-arid regions with low rainfall and poor soil conditions. It is highly drought-tolerant and can thrive in areas where other cereals may struggle.

Growing Conditions: It prefers warm temperatures and well-drained soils. It can tolerate higher temperatures than many other cereal crops.

Uses: Pearl millet is primarily grown for its grains, which are used for human consumption as well as livestock feed. It can also be used for forage.

3.2 Finger Millet (Eleusine coracana):

Suitability: Finger millet is another millet variety that can be grown in Tanzania, especially in the highlands and regions with moderate rainfall.

Growing Conditions: It is well-suited to areas with altitudes ranging from 1,200 to 2,400 meters. It can tolerate a wide range of temperatures and is relatively drought-tolerant.

Uses: Finger millet grains are used for human consumption, and they are particularly rich in nutrients. It is a staple food in some regions and can also be used for making various food products.

Both of these millet varieties have a relatively short growing season, making them suitable for areas where the rainy season is limited. Additionally, they are important crops for food security and nutrition, providing a source of carbohydrates and essential nutrients, especially in areas prone to drought.

It's important to note that local conditions can vary, and it's advisable for farmers in Tanzania to consult with local agricultural experts or extension services to determine the best millet variety and cultivation practices for their specific area. Additionally, selecting high-quality seeds and employing proper agricultural techniques can significantly enhance millet production. Such high-quality seeds shall be procured on cost of Tanzanian Agri-business Counterpart from ICAR institution by Nutrelis initially for at least 200 Acre each. Later-on other Millets like Fox-tail, Chena, Sanwa, etc shall be added after seeing the initial results. About 65% of the total production would be used as seeds with proper treatment in Seeds Processing Plant. The Tanzanian partner will support Nutrelis to establish a Seeds Processing Unit in Tanzania. This unit will be used for other crops certified seeds production like different cereals, pulses and oil seeds. It will facilitate the nutrition security to the masses in the country as well as series of self-employment opportunities and employment opportunities at decentralized level.

4.Other Perennial nature Commercial plantation and cultivation practices:

Some aromatic grasses of medicinal and fragrance importance like Lemongrass, Vetiver and plants like Moringa and Bamboo are also planned be cultivated in Tanzania. Each such crops/ plantations shall also be at least 200 Acre initially. Latter-on, the good quality planting materials shall be available for furthers expansion of the crops.

4.1: Morionga: The Moringa's incredible medicinal usage which is claimed by many cultures and communities based on real- life experiences are now slowly being confirmed by science. Through research, the Moringa was found to contain many essential nutrients, for instance, vitamins, minerals, Nutrition content of a plant plays an essential function in medicinal, nutritional, and therapeutic properties

4.1.1 There are many uses of Moringa tree. These are related to medicines, Human food, Water purification, Animal fodder, Alley cropping, Fertilizer, living fence, Living fence, Domestic cleaning agent, Fuel wood and other uses. Moringa increased physical energy - Tune your body up with naturally occurring nutrients to make your energy last longer. Numerous research reports reveal that, parts of Moringa plant can be used in different techniques. Moringa oleifera seed and leaves is advantageous source of nutrients, medicines, clean dirty water and it can be used for alley cropping; because, it has lots of leafy material. The uses Moringa oleifera are well documented by Fahey, as nutritional, industrial, medicinal, and agricultural advantage

4.1.2 Moringa oleifera has great potential for prevention of different diseases like nutrient deficiency, cancer, anemia as well as for dirty water purification. Moringa powder contains sufficient number of vitamins, nutrients and chemicals in it. This makes the tree a medicine for many different diseases. Moringa oleifera has also promoted by World Health Organization (WHO) as an alternative to imported food source to treat malnutrition.

4.2 Bamboo: Beema bamboo is a fast growing, dense, thornless and thick-walled sterile variety well suited as a power generation biomass feedstock. Bamboo (Bambusa Balcooa) is developed from the open pollinated population of bamboo found in West Bengal, followed by further selection and tissue culture work to improve and stabilize its yield and made the plant free from disease. The Beema Bamboo plant is not genetically modified organism and it is a product of conventional breeding which no way involved in gene modification. Bamboo is a tropical and sub-tropical species; better growth happens under high light intensity (10 to 14 hours of sunlight daily) with humidity more than 50%. Temperature should be above 10 Degree Centigrade and not more than 45 Degree Centigrade The water requirement is similar to sugarcane which is 2000mm/annum. The water requirement for bamboo would be 10 to 20 L per plant per day.

4.2.1 Intense Cultivation: Bamboo can be cultivated at 2500 plants per hectare similar to sugarcane cultivation with a spacing of 3m between rows and 1.2m between plants. The best suited irrigation is by drip along with fertigation system to supply required

fertilizer to the plants. The general requirement of fertilizer is 400:100:440 N:P: K per ha/year. The ultimate requirement of fertilizer and water would be decided based on the site condition, soil condition and water quality and rain fall pattern of the particular place. The recommended cultivation practice for Beema bamboo is "Precision farming" which involves application of required nutrient and water at the appropriate time and at the appropriate zone as per the requirement of the plant.

4.2.2 Plantation Size: The smallest economic plantation size should be about 80 hectares. Planning to final execution could span 6 to 12 months for 500 hectares depending on a number of variables. The first year would require about 250-man days per ha/yr, reducing to 100-man days/ha during the 2nd and 3rd years. During full harvest time the manpower will increase to 100-man days/ha.

4.2.3 Plantation Output: The harvest of the bamboo starts after 2 years (24 months). By then the bamboo would have grown to a size of 7.5cm at the bottom and 3.5cm at the top with a height of 4.5-6m, and each culm weighing 6-10 kg dry weight. Under ideal conditions each plant has 6 poles, amounting to 7kg of dry biomass weight at 10-12% moisture for each pole. Therefore, one hectare under ideal condition would produce 7kg x 6poles/plant x 2500 plants for a total of 105 tonnes/ha. By the 6^{th} year this output would rise to a maximum of 160 tonnes per hectare, which would be a steady output for over 35-40 years plus.

4.2.4 Fuel Character: The bamboo is one of the basic raw materials to Bio-energy industry. The different characteristics/ parameters of the bamboo are following:

Calorific value: Average 4000 k.cal./kg. (At par to regular coal)

Ash content : 1%

Bulk density : 0.4

Sulphur content: Nil

4.2.5 Biomass Energy Production: 1MW plant would require approximately 80-100 ha of bamboo cultivation area to maintain a continuous supply of Biomass feedstock.

4.2.6 Carbon Sequestration: One mature Bamboo will absorb maximum 500 kg of carbon dioxide per year. At full maturity, after the 5th year onwards, each ha under intensive cultivation would sequester 175 to 200 tonnes (metric) of CO2 per year. If the bamboo was gasified under pyrolysis, it would generate 16 to 19 tonnes of biochar / hectare, which if applied to the soil would further qualifies for additional carbon

credit where the carbon remains virtually permanent manner, while improving crop yield and soil quality.

4.2.6 Bamboo Plantation of one year old:

4.3 Cultivation of Lemongrass:

4.3.1 Name of Plant: Scientific Name Cymbopogon flexuosus (Steud.) Wats (Family Poaceae)**.**

4.3.2 Plant to employ in aromatic oil extraction: Green vegetative parts, mostly leaves are used for hydro-distillation of essential oil.

4.3.3 Characteristics of the plant: The plant is monocot belonging to grass family having no proper stem, However, leaf sheaths of several leaves form a strong tubular structure up to 10-25 cm from the ground level. Plant height varies from 1.5 to 2.5 m. Leaf sheath glabrous, hairy at the junction of the blade, blade about 1 m long, 1.5 cm wide. Linear sessile spikelets are 4.5-5.0 mm long. Upper glumes are boat shaped and lower glumes are nerved. The leaves yield 0.5-0.9% oil depending upon the cultivars, Major constituent of the oil is citral (75-85%)

4.3.4 Major production areas: The crop can be grown in tropical to semi-arid regions.

4.3.5 Characteristics of strain(s) for cultivation: Three different species of Cymbopogon viz. C. Flexuosus (Steud.) Wats, C citrantus Stapf and C. Pendulus are called as East Indian, West Indian and North Indian Lemongrass, respectively. All of them are grouped under the common name lemongrass because of the characteristic lemon like odour of their essential oil due to high citral content (75-85%) C. Flexuosus, also known as Malabar of Cochin grass, is indigenous to India, C. Citrates is mostly

cultivated in West Indies, Guatemala, Brazil, tec. Essential oil from the third species differ from the other two in lower solubility in 70% alcohol. This is due to presence of myrcene, which readily polymerises on exposure to air and light. Several cultivars viz. Sugandhi (OD 19), Pragati (LS48), Praman (Clone 29), PRL 16, CKP 25, Krishna, Cauvery, Chiraharit, Jama Rosa, etc. have been released from different institutes.

4.3.6 Cultivation methods:

4.3.6.1 Propagation: The crop is propagated through seed or slips.

4.3.6.2 Soil condition: The crop is traditionally grown in the poor lateritic soil of hilly regions of Kerala. However, growth and yield increase in good sandy-loam and loam soils. It cannot withstand water logging. It can be grown in soils having acidic to alkaline pH. Leaf yield, oil content and citral content increase with increase in pH from 4.8 to 7.5. It is also successfully grown in sodic soil having 9.8 pH and exchangeable sodium of 55%. The crop is found to grow in saline soil having electrical conductivity of 10 dSm without much loss in herbage and oil yields.

4.3.6.3 Climate: The crop is well suited for warm humid climate traditionally; it is grown in the areas receiving well-distributed high rainfall. However, it can be grown in semi-arid regions with irrigations. Oil content in leaves and citral content in oil is reduced in high rainfall areas though leaf yield increase. Low winter temperature inhibits the growth of this crop. Hence, leaf yield reduces in the areas having long winter season.

4.3.6.3 Planting time: The crop can be planted after winter (February-March) or during rainy season (June-July). Planting after winter is possible in the areas having assured irrigation. This also helps in minimizing the weed competition compared to rainy season planting.

4.3.6.4 Preparation of planting material: propagation through slips is practiced. Direct seeding does not give good stand hence not recommended. To raise the nursery, land is ploughed repeatedly to produce fine tilth. Nursery area of $1/10^{th}$ that of main land is sufficient. Raised beds of 1-1.5 m wide of convenient length are prepared. Seeds at 3-4kg per hectare are uniformly applied over the beds and covered with a thin layer of soil. Adequate soil moisture is maintained by watering. Seeds germinate with 5-6 days and seedlings get ready for transplanting at the age of 50-60 days. For planting of slips, clumps are trimmed from 20-25 cm above ground and dug out without injuring the roots. The individual slips or a group of 2-3 slips having enough healthy root system are separated just before planting. This minimises drying loss of the roots. Planting: In hilly regions, close planting (30x30cm) is done while wide spacing (45x60, 50x60, 60x60 cm)

is practised in northern plains. To avoid water logging, planting may be done on ridges in areas receiving high rainfall. Seedlings/slips are planted firmly in the soil but not deep in the soil.

4.3.6.5 Crop Nutrition: Lemongrass responds well to the applied nutrients. In general, 100 kg nitrogen (217 kg urea), 30 kg phosphorous (187 kg single supper phosphate) and 40 kg potash (68 kg muriate of potash) are applied for 1 ha land. Phosphorous and potash are applied as basal with one fourth of nitrogen. Rest of the nitrogen is applied in three equal split doses (after each harvesting). To avoid chlorosis, a mixture of 0.25% FeSO and 0.25% citric acid is sprayed 3-4 times at an interval of 7-10 days. However, now-a-days requirement of organically grown material is increasing; therefore, it can be cultivated with organic inputs only as per the norms of organic cultivation.

4.3.6.6 Irrigation: It Is generally grown as rain fed crop and no irrigation is required in the areas receiving well-distributed rainfall. However, 2-3 irrigations during hot summer months and one irrigation after each harvest can be applied to get higher yield.

4.3.6.7 Intercultural operation: Keeping the crop weed free during early establishment is essential to get good harvest. One or two times weeding after planting and one more weeding within 30 days after first harvest are recommended. Once the crop covers the land area, usually weed growth is reduced.

4.3.6.8 Diseases and pests:

Diseases like leaf blight (Curvulara spp. Dreschlera spp. And Colletotrichum graminicola) rust (Puccinia nakanishiki), smut (Tolyposporium christensenii) and grassy shoot (Balansia sclerotic) are noticed in this crop. However, none of them cause much damage to the crop. Among the insect pests, stem boring caterpillar of Chilotrea, scale insect (Duplachinoaspus divergens), white fly (Tetralaurodes semilunaria) and spittle bug (Cloira hipuctata) are important. Like diseases, the crop is not much damaged by the insects. However, if infestation of pests becomes serious, botanical pesticides may be applied.

4.3.7 Harvesting: Harvesting of tender crop is not advisable as oil and citral content remain in the lower side. Over mature and dried leaves also do not yield good oil. Under good rainfall areas first harvesting can be done at 3-4 months after transplanting. Thereafter, the crop can be harvested at a regular interval of 55-60 days. A total of 3-4 harvests in the first year and 4-5 in subsequent years are possible. Crop is harvested with sickle at 10-15 cm above ground level. Harvesting should not be scheduled at rain. Oil yield is increased with the age reaching maximum at third to

fourth year. Citral content of oil also increases with age of the crop. A well-maintained cultivation can provide economic return up to years. Flowering shoots need to be removed to reduce biological degeneration.

4.3.8 Processing: Oil in the herbage is distilled by hydro-distillation. Depending upon the distillation unit, complete distillation takes 3-6 hours. Chopping the grass before loading in the still for distillation allows packing of 40-45% more material and about 10% increase in oil yield with saving of fuel. Anhydrous sodium sulphate may be added in the oil and should be allowed to stand overnight and filtered to remove moisture and insoluble particles. To clean the dark colored oil steam rectification can be done. Oil should be stored in glass bottles or container made of stainless steel, GI, aluminum, etc depending upon the quantity.

4.4 CULTIVATION OF VETIVER

4.4.1 Name of the plant and it's family: Scientific name: *Vetiveriazizanioides*(Linn) Nash. (2n=20) (Family: Poaceae)

4.4.2 Plant part employed in aromatic oil extraction: The commercial essential oil of vetiver is obtained by distillation of the roots.

4.4.3 Characteristics of the plant: Vetiver (*Vetiveriazizanoides*(Linn) Nash.) or *Khus*of family Poaceae, is a perennial grass which can grow up to 1 to 2 metres high and form wide clumps. the plant stems are erect and stiff and the leaves are 120-150 cm long and 0.8 cm wide and rather rigid. the panicles are 15-30 cm long, brownish-purple in colour and have whorled 2.5-5.0 cm long branches. the spikelets are in pairs, and there are three stamens. the root system of vetiver is finely structured and very strong. it has no stolons or rhizomes. Unlike most grasses, which form horizontally spreading mat-like root systems, vetiver's fibrous roots grow downward, 2-4 m in depth, and are strongly scented. Vetiver is mainly cultivated for the fragrant essential oil distilled from its roots. the main chemical components of the oil are benzoic acid, vetiverol, furfurol, vetivone and vetivene. Due to its excellent fixative properties, it is used widely in perfumes. Dry roots are also used for making mats, fans, screens, pillows, baskets, incense sticks and sachet bags. Since plant has extensive fibrous roots, it is useful in both soil and water conservation. it helps in maintaining soil moisture, absorbs toxic substances in chemical fertilizers and pesticides and improves physical characteristics of soil. the plant is one of the best soil binders and is used through tropics to check soil erosion by planting along contour. Grass is also widely grown as a protective partition in terraced fields and as a border for roads and gardens.

4.4.4 Major production areas: ts main producers are tropical Asia, Africa, Australia, Haiti, indonesia, Guatemala, india, China and Brazil. Crop is also cultivated in indonesia, Malaysia, Philippines, Japan, Angola, Belgian Congo, Dominican Republic, Argentina, British Guiana, Jamaica, Mauritius and Honduras.

4.4.5 Characteristics of strain (s) for cultivation: it is non-seeding type, high yielding both in terms of root bio mass and oil. it is reproduced by vegetative propagation and it is the type suitable for erosion control. Among South Indian types, Pusa Hybrid-7, Hybrid-8, CIMAP- KS-2, Sugandha, KH-8, KH-40 and ODV-3 are varieties available for commercial cultivation. Cultivars Dharini, Gulabi and Kesari released by CIMAP, Lucknow were developed by repeated selection of germplasm collections from different parts of india.

4.4.6 Cultivation methods:

4.4.6.1 Soil: Vetiver can be grown on almost every kind of soil. However, light soils, should be avoided as the roots grown in this soil produce very low percentage of oil. Well drained sandy loam and red lateritic soils rich in organic matter are considered to be ideal for cultivation. it can also be cultivated in clay loam soil but it is better to avoid clayey soil. it can be grown in wide pH range even in saline and alkaline soils with a pH of 8.5 to 10. A flat site is acceptable, but watering must be monitored to avoid water logging, that will stunt the growth of young plantlets. Mature vetiver, however, thrives under waterlogged conditions. it can also absorb dissolved heavy metals from polluted water and can tolerate arsenic, cadmium, chromium, nickel, lead, mercury, selenium and zinc.

4.4.6.2 Climate: Vetiver is tolerant to a wide range of temperature ranging from -15 °C to +55 °C, depending on growing region. the optimal soil temperature for root growth is 25 °C. root dormancy occurs when temperature goes below 5 °C. Under frosty conditions, shoots become dormant and purple, or even die, but the underground growing points survive and can regrow quickly if the conditions improve. Shading affects vetiver's growth, but partial shading is acceptable. it is tolerant to drought, flood, submergence and grows luxuriantly in places having moderately humid climate with annual rainfall of 1000 to 2000 mm. it can also be grown as an irrigated crop in other suitable places with scanty rainfall.

4.4.6.3 Propagation: Vetiver can be propagated either by seeds or slips, but slips are commonly used. the cultivated accessions which are propagated through vegetative

means show limited variation, whereas, seed propagation is used for breeding new varieties. Seed yield varies between 400-650 kg/ha. Freshly collected spikelet show dormancy and require an after-ripening period of about 3 months. Removal of caryopsis from enclosed husk facilitates germination. Dormancy can also be broken by treating the seeds with giberalic acid or potassium nitrate. Most of the spikelets are not subjected to fertilization and seeds which sometimes produced are very thin and are having a short dormancy period. in these non-seeding types, slips are separated from clumps of previous crops with rhizome portion intact having 15-20 cm of aerial portion is used for propagation. Slips thus obtained should be kept moist and stored in shade. Dry leaves should be removed from slips before transplanting to avoid carry over of pests and diseases.

4.4.6.4 Planting time: The most suitable time for planting vetiver is with the onset of monsoon.

4.4.6.5 Land preparation: Land is ploughed to a depth of 20-25 cm by 2-3 deep ploughings and removes the perennial weeds. Recommended dose of farm yard manure or compost and fertilizers are applied and mixed well with the soil. in sloppy areas pits are taken across the contour.

4.4.6.6 Planting: The mother clumps can be divided in to small pieces to give much number of slips. Slips are separated from the clump with the rhizome portion intact having 15-20 cm of the shoot portion. While planting slips fibrous roots and leaves should be trimmed off. Ensure planting of slips at the correct time. Slips from healthy and disease-free clumps are planted during June-July with the onset of monsoon vertically about 10 cm deep at a spacing of 60×30 cm / 60 × 45 cm / 60 × 60 cm based on soil fertility status, climate, variety and irrigation facility. Plant population varies from 27,800 to 1,10,000 plants/ha. If irrigation facilities are available, it is better to plant during March-April, and frequent irrigation will be required. Late planting resulted in the production of coarse roots which yield inferior quality oil.

4.4.6.7 Crop nutrition: Normally, fertilizer application for vetiver is not practiced in fertile soils. But, on poor soils, 10 tons of FYM along with 25-50 kg/ha each of N, P_2O_5 can be applied. Care should be taken to apply N in 2-3 split doses. N: P_2O_5:K_2O dose of 60:22.5:22.5 is recommended.

4.4.6.8 Irrigation: In the absence of rainfall, soil moisture status should be maintained by irrigation from planting to establishment. in the areas where rainfall is good, well distributed over the year and humidity is high, supplementary irrigation is not necessary. However, in dry areas about 8-10 irrigations will be required to get the optimum yield. Apply mulch to conserve soil moisture. irrigation should be discontinued 7-10 days before harvesting.

4.4.6.9 Intercultural operation: In case of newly established crop, 2-3 weeding and earthling-up at an interval of one month are needed during initial period of plant growth. Once the crop is established, weeds are kept under check because of vetiver's thick and dense shoot cover. Aerial portion is trimmed at 20-30 cm above ground level thrice during the entire cropping period of two years. First trimming should be done at 4-5 months after planting, second during second year just before flowering and third in second year winter season, about one month before digging of roots.

4.4.6.10 Plant protection Insect pests: Vetiver is a hardy crop and infestation by pests is not a serious concern. However, in dry areas termites are seen damaging the crop. Grubs of beetle *Phyllophagaserrata*have also been reportedly infesting vetiver roots. these can be controlled by broadcasting neem cake @ 5 t/ha before final ploughing. Stem borer, *Chilo sp.* and scale insects are also a threat in some places to the commercially grown vetiver. remove the leaves and plants severly infested by scales and spraying with neem oil 5% also reduces scale infestation. Nematode infestation of roots by is also reported. to prevent nematode infestation caused by *Heteroderazeae,* use nematode free healthy mother stock. High organic matter content of the soil, hot water treatment and application of neem cake @ 5 t/ha are also found effective in controlling nematode.

4.4.6.11 Diseases: During rainy season the plant is infested by *Fusarium* sp. Leaf blight caused by *Curvulariatrifolii*is another important disease during rainy season. the infested leaves bear tan to dark spots which turn black with age. the roots of affected plants become yellow and gradually dry out. these pathogens can be controlled by 2-3 spraying or drenching of copper oxy chloride 0.3%.

4.4.6.12 Harvesting: The time of harvesting of vetiver roots is very important as the yield of roots and oil percentage vary with changes in environmental conditions. roots are harvested after 15-24 months of planting, but to obtain good quality oil it should be harvested at 18 months. though, early harvesting gives higher essential oil yield, oil

will be of low specific gravity which also lack valuable high boiling constituents. if roots stay in ground for over two years, oil quality improves but yield diminishes considerably. Crop is generally harvested during December - February by digging out the clumps along with its roots manually. A tractor drawn mould board plough can also be used for digging out roots up to 35 cm depth. Mechanical harvesting gives 15% higher roots recovery over manual harvesting.

4.4.6.13 Processing: The harvested roots are separated from the aerial parts, washed thoroughly, chopped to shorter lengths of 5-10 cm to facilitate easy drying and then dried under shade for 1-2 days before distillation, which improves the olfactory quality of the essential oil, while prolonged sun drying reduces the oil yield. While drying, roots should be laid out in thin layers and this will prevent the chances of fungal growth that results in decomposition of root. Do not dry the roots on the ground in direct sunlight without close supervision as direct sunlight involves a high risk of degradation of its active principles.

After drying, the oil is extracted from the roots through hydro or steam distillation. in North indian varieties, distillation process is completed in 12-14 hours, while South Indian varieties require a long duration of 72-96 hours, as it has low volatile oil and high boiling point. two distinct fractions, one lighter than water and another heavier than water is obtained from vetiver. Heavier the oil better is the quality. After distillation is completed, these fractions should be collected separately and later mixed together. the oil is then decanted and filtered. The distilled oil is treated with anhydrous sodium sulphate or common salt at the rate of 20 g/litre to remove the moisture. Oil obtained from stored roots is more viscous and possesa slightly better aroma than that obtained from freshly harvested roots. Fresh roots require less time for distillation and gives maximum oil yield.

The vetiver oil is amber brown and rather thick. its odour is described as deep, sweet, woody, smoky, earthy, amber and balsam. Ageing of the essential oil for a period of six months improves the odour of the oil substantially wherein, the `harsh' `green' and `earthy odour' characters of the freshly distilled oil get converted in to a fuller, heavier and sweeter odour. the oil should be stored in sealed amber coloured glass bottles or containers made of stainless steel, galvanised tanks, aluminium containers and stored in a cool and dry place. All processing activities should be documented in a diary.

4.4.6.14 Expected yield the essential oil yield of vetiver roots varies considerably and it depends on a number of factors such as soil conditions, age of the roots, harvesting time, drying and distillation methods followed etc. On an average the root yield may range from 3-4 tonnes per hectare from a two-year-old plantation. in sandy and sandy loam soils, root yield is as high as 2-2.5 tonnes /ha whereas; in salt affected areas only 1-1.5 tonnes of roots can be harvested per hectare. Oil recovery from fresh roots is 0.3-0.8% and from dried roots it is 0.5-3.0% depending upon the duration of distillation. On an average the oil recovery is around 1% on dry weight basis and 15-30 kg oil is obtained per hectare per crop.

5.0 Biomass (Dry & woody nature) based Bio-coal (Palates and briquettes):

The proposed unit will manufacture Bio mass briquettes/ pellets, White coal from Residues like Agriculture waste, Forestry waste, Agro – industrial waste, Tree shaping waste, Park and garden waste, Sabji Mandi waste, Waste Vegetable, Fruit waste, Local weekly bazaar waste, Leaf, Grass, Organic waste, Coconut waste, Biomass waste, Dry fruit waste, Flower waste, Road side bushes, STP sludge etc (All is count Bio-mass) etc in front of briquettes has been named as briquetted white coal. It can be efficiently used to replace coal and fire – wood. Bio mass is organic material of recent origin that can be used as a source of energy it is generally includes crops and other plants well as agricultural, forest, agro-industrial waste, fruit, vegetable, road side bushes and sawdust etc.

Every day app. Million tons of waste get generates these are either not used or burnt inefficiently in their loose form causing Air pollution, dumping problem, Handling and transportation of this material is difficult due to low bulk density. The process of converting low bulk density agricultural residues, forestry waste, organic waste, industrial waste to solid cylindrical shape using hydraulic pressure without using any **binders or chemicals**. This white Coal is substituting fuel energy.

Briquettes have high specific density (1200kg/ m3 and bulk density (800kg/m3) compared to 60- 180 kg Density of loose Bio-mass with a low moisture level of 8-10% Every year millions of tons of agricultural waste are generated, these are either not used or burnt inefficiently in their loose form causing air pollution, handling and transportation of this material is difficult due to low bulk density. Such agricultural residues would be aggregated by farmers of FPOs and sold to such units as raw materials.

5.1 SIGNIFICANT SOURCE OF RAW MATERIAL:

5.1.1 Major Sources: Agriculture waste, Forestry waste, Agro- industrial waste, Tree shaping waste, Park and garden waste. Sabji Mandi waste, waste Vegetable, fruit waste, Local weekly bazaar waste, Leaf, Grass, Organic waste, Coconut waste, Biomass waste, Dry fruit waste, Flower waste, Road side bushes.

5.1.2 Other Sources: Play wood industry waste, Wood workshop waste, Sugar Mill waste, Rice Mill waste, Oil based industry waste etc.

5.2 ALTERNATE SOURCE OF ENERGY: As we are all aware with the importance of fuel, it is the heart to the any of the countries; Energy is the key factor in economic development of every country. The Demand of Energy is increasing and the supply is limited. This has resulted in a huge shortage of coal natural gas, kerosene, diesel, lignite etc. and gap between the Demand and supply of energy. But the prices these fuels are very high, due to the high increasing Demand of energy, The white coal is an ideal fuel which substitute coal, fire, wood-lignite, and other converting fuel for heating steam generation. Biomass is the best alternate source of energy.

5.3 ADVANTAGES OF BIO-MASS WHITE COAL: Advantage of Bio-mass white coal is ecofriendly, renewable energy fuel, lower ash content, thermal calorific valve app.3000-4500 k cal/kg consistent high burning efficiency, Higher fire Carbon value, Economical and cheaper than other fossil fuel.

5.4 POLLUTION: Briquettes are immeasurably cleaner than the other fuel alternatives specially coal! because it does not contain any Sulphur. Dust pollution associated with direct combustion of loose biomass can be avoided switching over to Briquettes. Moreover, the chance of fly ash is minimizing when Bio Coal Briquettes are burnt. Considerable reduction of fine dusts and other wastes through compression of the material, into clean and compact briquettes Reduction in the danger of fires and explosions by briquetting flammable waste the economic solution to costly fire prevention measures

5.5 EFFICIENCY: Uniform physical dimensions & combustion characteristics, results in more efficient energy conversion. Briquettes burn in a controlled manner, slow and efficient because of lower moisture content, higher bulk density, & lower ash content. More and more, utility Industries are using biomass briquettes to supplement or replace coal as a solid fuel source.

5.6 COST: The purchase price of biomass briquettes is less than regular Coal, Fire wood.

5.7 QUALITY AND CLEAN FUEL: Biomass Briquettes has consistent quality & it is very clean to handle.

- Eco-friendly
- Renewable energy fuel
- Lower ash content
- Solve dumping problem
- Reduction in environment pollution
- Reduction in usage of conventional fuels
- Improving the nation economy
- Employment generation/ job creation
- The environmental benefits include reduction in air and water pollution
- Pollution free and no hazard and no sulphur
- It is useful for electrical energy can be produced in large scale at low cost
- High burning efficiency, higher boiler efficiency as a result of low moisture and high density
- Cheaper as compared to coals
- Easy handling, reduces transportation cost
- Save energy, clean energy, clean environment
- Economical and cheaper than other fossil fuel

5.8 BIOMASS BASED BIO-COAL USES FOR VARIOUS INDUSTRY: Here-under are the list of Industries where such bio-mass based bio-coal will be used as green fuels:

• Distilleries	• Power plant
• Brick Kilns	• Dying unit
• Leather industries	• Rubber industries
• Garment industries	• Hotel, Dhaba
• Polymer Industry	• Paper mills
• Cement Plant	• Gasifies
• Food processing industries	• Parma industries
• Tyre retreading units	• House hold boilers
• Vegetable plant	• Textile units
• Sugar cane mills	• Lamination industries
• Milk Plant	• Chemical plant, Bakery industries
• Any Type of boiler application industries	

5.9 COLORIFIC VALUE OF BRIQUTTES FROM VARIOUS RAW MATERRAL FOR FUELS:

S.NO	Type of Material	Heat of Combustion	Ash in (%)
1.	Peat	3180	29.0
2.	Charcoal	7213	4.5
3.	Bagasse	4380	1.80
4.	Coir Pitch	4146	9.10
5.	Sugarcane	3996	10.00
6.	Jute waste	4428	3.00
7.	Palm Husk	3900	4.90
8.	Tea Waste	4237	3.80
9.	Barks Wood	1270	4.4
10.	Wood Chips	4785	1.20
11.	Paddy Straw	3469	15.5
12.	Wheat Straw	4100	8.00
13.	Mustard Stalk	4200	3.40
14.	Mustard Shell	4300	3.70
15.	Bamboo Dust	4160	8.00
16.	Forestry	3000	7.00
17.	Babool (Wood)	4707	0.90
18.	Tobacco Waste	2910	31.5
19.	Sunflower Stalk	4300	4.3
20.	Soya Bean Husk	4170	4.10
21.	Groundnut Shells	4626	2.4
22.	Briquettes of Bark	4487	3.4
23.	Coffee Waste No-1	4371	2.0
24.	Coffee Waste No-2	4434	5.0
25.	Coffee Waste No-3	4438	1.7
26.	Briquettes of Chips	4800	3.0
27.	Briquettes of Paper	4841	1.5
28.	Castor Seeds Shells	3862	8.00
29.	Saw Dust	3898	8.2
30.	Cotton Stalks/ Chips	4252	3.00

31.	Briquettes of Papyrus	3965	5.6
32.	Briquettes of Sawdust	4654	0.7
33.	Briquettes of Rice husk	3881	15.0
34.	Briquettes of bark and binder	4459	4.8
35.	Briquettes of groundnut shells	4661	2.8
36.	Briquettes of straw and coal dust	4826	6.1
37.	Briquettes of clean chopped straw	4403	5.3
38.	Straw + Coal dust + rape seed waste	4100	3.8
39.	Briquettes of shells from palm oil kernels	4985	2.0
40.	Sewage sludge (dry)	2989	10

5.10 FLOW CHART OF MANUFATURING PROCESS: -

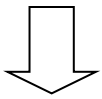
Procurement of Raw Material
(From farmers land & all other sources in dry condition)

Shredding & Chipping Process

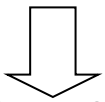
Dryer Process (for evaporation of moisture)

Manufacturing of Briquettes, Pellets

Testing of Calorific Value & moisture contents



Packing



Delivery & Dispatch

6.0: Wet-Biomass based Bio-gas/Bio-CNG production: (Family Size& Community Size)

SALIENT FEATURES

1.	Our Mission Objective	:	Self-reliant in our energy requirements through new and renewable resources.	
2.	Our Dream	:	Energize each and every rural household of U.P. through Community Bio-Gas Project/ Family Size Bio-Gas Projects based agricultural/ animal husbandry waste	
3.	Phase-wise use of Bio-gas	:	(a) First Phase	For cooking & lighting gas in the villages.
			(b) IInd Phase	For decentralized electricity generator units at village level under it's development model "SPEED"
4.	By Produce from the Bio-gas unit	:	Good quality compost for our mother earth nourishing.	
5.	Impact on the environment	:	Establish long lasting solutions to bio-degradable waste management, help to reduce PM-2.5 & PM-10 and also promote carbon neutral economy and finally provide measures for reducing global warming.	
6.	Indirect & sustainable benefits to our Community	:	Carbon credit facility from " Kyoto Protocol" as Methane is 22-24 times more hazardous than co_2	
7.	Employment opportunities	:	Direct & indirect employment to rural masses at their door step as each Community unit of	

			100 cubic meter capacity will provide self-employment opportunities to about 4 youths on sustainable basis.
8.	Opportunities of Developing/ Strengthening other sectors.	:	1. Dairy. 2. Organic Farming. 3. Organic Food Processing Industries. 4. Misc. other activities.

6.2 TOTAL RURAL SANITATION CAMPAIGN & BIO-GAS UNIT FOR CLEAN FUEL TO EVERY HOUSE HOLD IN RURAL AREA:

6.2.1 Background : Swaksh Bharat Mission-Gramin has been focusing on safe disposal of human excreta by promoting construction of sanitary toilets and creating open defecation free environment. SBM-G implementation may be considerably improved if community based incentive scheme launched by Govt. of Tanzania. Currently, the primary objective of the SBM-G Campaigning in India is to address the knowledge and practice of safe disposal of human faucal through a range of on plot and off plot technical options. This is based on the assumption of primary research that indicates high correlation between unsafe human faucal disposal and the prevalence of gastro intestinal illnesses. However, recent research by WHO (2004) and supporting studies by Godfrey et all (2005) indicate that prevalence of specific micro-organisms derived from animal source (E Coli 0157:H7, Enterococcus, Rotavirus and Cryptosporidium) suggest that management of human faces alone is insufficient in breaking the “true” faucal-oral-transmission route. Hence, there is a need to focus on animal waste management. We may prepare the guidelines of SBM-G to incorporate a provision of solid and liquid waste management also having both types of wastes of human as-well-as animal and other wet bio-degradable waste.

6.2.2 Health Risk : Livestock activities have significant impact on almost all aspects of environment including air, land, soil, water and biodiversity. The livestock business contributes among other things to water pollution, euthropication and the degeneration of coral reefs. Livestock are estimated to be the main inland source of phosphorous and nitrogen contamination and one of the leading factors for nitrate pollution resulting in blue baby syndrome (Steinfeld et al, 2006). However, as well as chemical contamination, animal waste is a significant source of microbiological contamination of drinking water sources as well as the cause for subsequent disease burden. One of the major causes of mortality and morbidity among children below 2 years of age is rot viral infection. The major source of rotavirus is animal faces and the

consequent drinking water contamination in rural areas.. Despite the global recognition of animal waste as a major source of rotavirus, there have been limited environmental sanitation drives to reduce the prevalence and viral transmission in rural India.

Traditionally, the cattle-dung, together with house sweeping, is collected in the open backyard, and removed from the homestead using drawn carts. The dung is removed to another heap or to an uncovered pit in a common plot outside the village. The loose heaps lie exposed to the sun, with the result that the raw organic matter dries up quickly and does not fully decompose. Very often, a part of the dry dung is blown off by wind or washed away by rain. This can cause eutrophication of surface waters, degradation of ground water quality, and threats to human health. Furthermore, historically, animal waste is used as manure and land application of manure is considered to be the best option for animal waste management. Poor management of cow dung and inadequate hygiene practices are also responsible for contamination of the milk produced. Cow-dung is also primarily responsible for growth of parasites causing deadly Alzheimer (kalazar) disease. Similarly, agriculture wastes also cause various health hazards.

6.2.3 Opportunities: The most common way of disposal of cow-dung in rural areas is to convert it into dung cakes which are burnt as fuel in rural households. Burning the cow-dung not only adds to carbon emission which is a greenhouse gas leading to ozone layer depletion but also is an inefficient way of using the dung which is rich in calorific value and can generate efficient form of fuel if properly decomposed in a bio-digester. Anaerobic decomposition of organic waste leads to methane production which is a good fuel. As per calorific value table one kg of methane gas is more or less equal in energy content to one kg of petrol, LPG, kerosene or diesel. It has already established that one cow gives enough cow-dung in a year to produce methane gas equivalent to 255 liters of petrol in energy terms.

The large scale availability of cow-dung and other organic waste in rural areas can be used to produce methane gas in an organized way. Generation of methane in this manner or “methane farming” has the potential to counter the skyrocketing prices of crude oil and emerge as an alternative to fossil fuels whose stocks may be depleted in the next 30-40 years. It is estimated that with existing cattle population, India can produce enough methane gas to replace majorly LPG and kerosene in cooking in rural area, substitute petrol in transportation up to major extent. Methane gas can also generate enough electricity to meet all requirements, at least in rural areas. The by-

product can serve as excellent organic manure, substituting chemical fertilizers which require CNG as one of the major feedstock.

6.2.4 Technology: Obtaining Methane Gas from cow dung is a simple process. When organic material decays it yields useful by-products. The nature of the by-products depends on the conditions under which the decaying process takes place. It can be *aerobic* (with oxygen) or *anaerobic* (without oxygen). It is possible to mimic and hasten the natural anaerobic process by putting organic wastes (manure and vegetable matter) into insulated, air-tight containers called digesters. Digesters are of two types:

1. Batch-load digesters which are filled all at once, sealed, and emptied when the raw material has stopped producing gas; and
2. Continuous-load digesters which are fed a little, regularly, so that gas and fertilizer are produced continuously.

The digester is fed with a mixture of water and wastes, called “slurry”. Inside the digester, each daily load of fresh slurry flows from one end and displaces the previous day’s load which bacteria and other microbes have already started to digest.

Each load progresses down the length of the digester to a point where the methane bacteria are active. At this point large bubbles force their way to the surface where the gas accumulates. The gas is very similar to natural gas and can be burned directly for heat and light, stored for future use, or compressed to power heat engines. This gas has 65-66 per cent methane, 32 per cent carbon dioxide, rest hydrogen sulphide and moisture. It is passed through lime water to remove the carbon dioxide and over iron fillings to remove H_2S. It then becomes enriched with methane. A compressor can extract and compress this methane gas into portable cylinders. These methane gas cylinders can then be used for cooking, or in automobiles and two wheelers. A community unit may provide piped gas to house-holds whether in rural or urban areas.

As much as 20 per cent of the cow dung slurry and other agro-waste is available as leftover in the biogas gas plant, which then can be used to produce organic manure rich in nitrogen and phosphorus.

6.2.6 The Economics of Methane farming:

1. LPG is generally used for cooking in urban areas while kerosene is the preferred fuel in rural India. A 15 kg. LPG cylinder lasts about 20-25 days for a family of 7-8. This Works out to 20 cylinders of LPG per house hold per year or an equivalent quantity of kerosene. It may be replaced majorly by Bio-Gas units.

2. A generator needs 200 gm of petrol to produce one kilowatt/hour (kwh) of electrical energy. The per capita electrical energy consumption in rural area is 180.4 kwh per annum. It may be also be replaced majorly by Bio-Gas units by running off-grid small capacity generators.
3. This process leads to safe disposal of organic waste and the methane generated is used as fuel, this process saves the greenhouse gas emission and the quantum of methane generated is likely to earn carbon credits as part of the ***Clean Development Mechanism*** (CDM) which can generate sufficient fund for taking up methane farming on a large scale.
4. In Indian conditions, It is estimated that an initial investment of about Rs. 1.20 Lakhs for a family (Assuming 7-8 persons in a family) size unit and about Rs 40.00 Lakh is required for a community Bio-Gas Unit which can provide piped bio-gas to a village hamlet having about 35 households with maximum distance of 200 meter radius. The plant can be easily operated at village level by local entrepreneurs as well as women self-help groups. Further details about the cost of both the models as well as execution mechanism shall be submitted if our proposal is shortlisted for financial support.

6.2.7 Advantages:

1. **Sanitation:** with proper management of animal and other agriculture /organic wastes/ the village will be clean leading to better health and hygiene.
2. **Energy security:** conversion of organic waste into methane and its use as fuel will lead to energy security because fossil fuel is not going to last for more than 30-40 years.
3. **Pollution control:** Normally aerobic decay of organic waste leads to emission of greenhouse gases like carbon dioxide or carbon monoxide. The process of Mehta nation reduces greenhouse gas emission and helps in arresting depletion of the ozone layer. This is likely to earn carbon credits.
4. **Employment generation:** Such plants can be easily set up and operated at village level and can be managed by women self-help groups or local entrepreneurs with lower per capita investment. Since the product has a captive market the plant is bound to be economically viable and it can also generate employment opportunity for a large number of people.
5. **Natural Farming:** It will support the natural farming campaign of Agriculture Ministry of Tanzania (If any).

6.3 Proposed opportunities to establish such units at village level: The proposed Biogas plant model has more advantages than the traditional fixed dome plant. Some of the major advantages of the Biogas plant over other plants are listed below.

1. **Easy to build and fast**: This Bio gas plant is made by concreting with the help of frame. Hence, it is easy and fast to build the plant. The Casting of whole plant can be completed in one-day work after digging the hole in the ground. There is no need of soil as in the case of traditional fixed dome plant for casting the digester.
2. **Industrial Scale**: The traditional biogas plant cannot be used to make large plant in industrial scale. This model can be used to make the plant of strong strength with larger volume than other models.
3. **Solid Organic Materials:** like grass, straw can be used. Traditional biogas plant is mainly dung based but this biogas plant can use any solid biodegradable material. When this biogas plant is used as batch plant, there is regular discharge of gas for long time .
4. **Easy to Repair**: The gas holder is perfectly below the water. Hence any leakage of the gas can be seen easily and repaired immediately. The digester has 1.5 m diameter hollow part in the top(in which gas holder stands). So it is easy to repair the digester also.
5. **Durable**: This Biogas plant is concrete plant. So it can last for 30 years or more. The gas holder can last for 10 or more years.
6. **Safe**: When the Gas holder is taken out, there is no gas in the digester. So it is safe to repair the plant and to replace the solid biomass like grass and straw.
7. **Purity in the Gas**: This model consists of de-sulfurizer to absorb the unwanted sulfur compounds (H_2S, SO_2). This will help to show that biogas is odorless gas.
8. **The Slurry**: From this plant waste materials are perfectly digested. It consists of 90% of water.
9. **The Inlet and Outlet:** Can be constructed as required by the users.
10. This biogas plant is completely submerged in the ground. So it is very **attractive** than other plants.
11. **All other wastes** (except Plastic, highly acidic and basic materials) can be feed to this plant.
12. This plant **does not require daily water addition** because it is completely submerged below the water. The feeding material takes the required amount of water.

7.0 Financial Requirements of the proposed project: The proposed project will cost Rs 1710.00 Lakh ($ 20.48 Million). The details are following:

Sl. No.	Particulars	Cost in Rs Lakh (Year wise)			
		1	2	3	Total
1.	Training and awareness to farmers	100.00	50.00	50.00	200.00
2.	Cost of cultivation to the tune of producing good quality planting materials of 1. Millets (200 Acre) 2. Herbal & Aromatic Plants(200Acre) 3. Tissue culture Bamboo(200 Acre)	270.00	-	-	270.00
3.	Essential Oil Steam Distillation Unit -5	100.00	-	-	100.00
3.	Establishing Certified Seeds Production Unit-1	300.00	100.00	-	400.00
4.	Millets processing unit including bakery unit-2	150.00	-	-	150.00
4.	Woody nature bio-mass waste to Pallets/ Briquettes production unit-1 (20 MTPD)	180.00	50.00	-	230.00
5.	Wet/ Flashy bio-mass based Bio-gas units 1. Family Size: 50 Units 2. Community Size : 5 Units	260.00	-	-	260.00
6.	Administrative and expert/ professional	50.00	25.00	25.00	100.00

	Charges				
	Total	1410.00	225.00	75.00	1710.00

8.0 Proposed Outcomes: The proposed project will add values to the Country's Economy as well as create a stream of environment-friendly sustainable development. Other expected visible outcomes are following:

1- Millets production: Approx 80-100 MT (about 40% of this production would be used as seeds for next year ad rest would be used as nutritional grains). Create about 4000 Man days of seasonal employment and 25 regular employments.

2- Herbal and Aromatic Plants: Approx 12000 Kg Lemongrass Oil and 1250 Kg Vetiver Oil. Create about 10000 Man days of seasonal employment and 30 regular employments.

3- Bamboo Production: (3rd year on-ward and up to next 40 years): 10000 MT. Create about 6000 Man days of seasonal employment and 20 regular employments.

4- It will replace 300 LPG cylinders on regular basis to meet the cooking fuels in the rural house-holds.

5- It will replace about 20 MT regular coal by facilitating agriculture waste/ bio-mass based pallets/ briquettes through the year. The consumer of this product may be any industrial user who uses coal.

6- It will support to the country for developing green economy. Ultimately, it will open a new window to earn carbon credits.

7- A team young agripreneurs/ entrepreneurs shall be developed to establish a self-propelled mechanism of climate resilient sustainable development of the country.

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