

## **Rural Industrialisation – Leaf to Root approach**

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*“Not mass production but production by the masses” – Mahatma Gandhiji.*

*“Small is beautiful” – Dr.E.F.Schumacher.*

**While inaugurating the 93<sup>rd</sup> Session of Indian Science Congress at Hyderabad (January 2006) our Prime Minister urged scientists to develop technologies which used labour and at the same time were efficient in both farm and non-farm business. For, even as the share of agriculture in national income was falling fast, the proportion of the population dependent on agriculture did not decline as rapidly, leading to rural distress and enforced migration to urban areas. This is a timely call.**

The goal of any country is development. Development is development of people – their increased living standards and improved quality of life. Industry provides goods, services and material comforts to increase living standards. Social values such as human dignity, self-reliance and gainful employment for every person set the quality of life.

Such development can only come by generating, mobilizing and optimally utilizing natural and human resources, natural genius and skills and maximizing the returns for the same.

Majority of the people live in rural areas. The question then arises as to how to maximize the returns, let us say, for a hectare of land. On land, we have soil, water, forest or agricultural crop, animals and people – under a given

climate. How to maximize the returns for these resources is the issue.

How to grow more crops, get better yields is one aspect: Soil-water management, better seeds, fertilizers, pesticides and farming techniques etc. have given good results. But these involved high-energy inputs. The emerging technologies like tissue culture, genetic engineering etc. offer great promise.

Past experience has clearly shown that rural industrialization is not setting up large industries in rural areas. We are also fed up with the opiate that rural development is synonymous with agricultural development. True, rural people live on land and agricultural development is a must. But it is not enough. Agriculture should have a nexus with industry. In food crops, the proportion of agricultural residues to the food obtained for human consumption is approximately 1.5 to 1 for roots and tubers; 2 to 1 for cereal grains; 6 to 1 for oil seeds and 10 to 1 for sugar crops.

### **Leaf to root concept**

Every part of the agricultural plant must become a raw material for industries. For example, several industries may be set up around paddy plant. Straw may be used for making card boards, wrapping paper, roof thatch; bed for mushrooms, apart from animal fodder. Paddy husk may be used as fuel and the resultant ash for producing sodium silicate, solar grade silica, silica sol, ceramic materials and refractories and cement like products. It can also be used for making particle boards, activated carbon, furfural, fillers and extenders, fire resistant compositions. Paddy husk is used by brick manufacture, for mulching, soil reclamation and as filler in fertilizer industry and animal feed. Rice bran is extracted for oil for edible and non-edible purposes like soaps, detergents, paints etc. The deoiled rice bran contains

20 – 22% protein and used as animal fodder. Rice as such is used for food and several food products for use in beer, wine and several starch – based industries.

Similarly 25 industries could be started around sugar cane; 7 to 12 industries around cotton and groundnut etc.

Sugar industry produces three principal residues, namely, bagasse, press-mud and molasses. These residues are no more wastes, if utilized properly to get various valuable products. The main product of the sugar industry – sugar – is used as an item in food and as a raw material in chemical and bio-chemical industry. Bagasse is mostly used as a fuel in the sugar industry. It is also used for the manufacture of paper. If alternate source of energy is available to the sugar mills, large quantities of bagasse would be available for the manufacture of pulp, paper, and boards, furfural, activated carbons and other products. The pith can continue to be used as a fuel while the depithed bagasse can be used for the manufacture of pulp and paper. Along with other cellulosic wastes, bagasse can be used as a source of energy for enzymic and microbial reactions to produce single cell proteins (SCP) and sugars.

Molasses is used for the production of alcohol, yeast and animal feeds. Production of organic acids from molasses include: acetic acid (vinegar), citric acid, lactic acid, glutamic acid, itaconic acid, aconitic acid, fumaric acid, malic acid. Oxidation of molasses will give oxalic acid.

The types of yeasts produced from molasses are: baker's yeast, food and feed yeast and fat yeast.

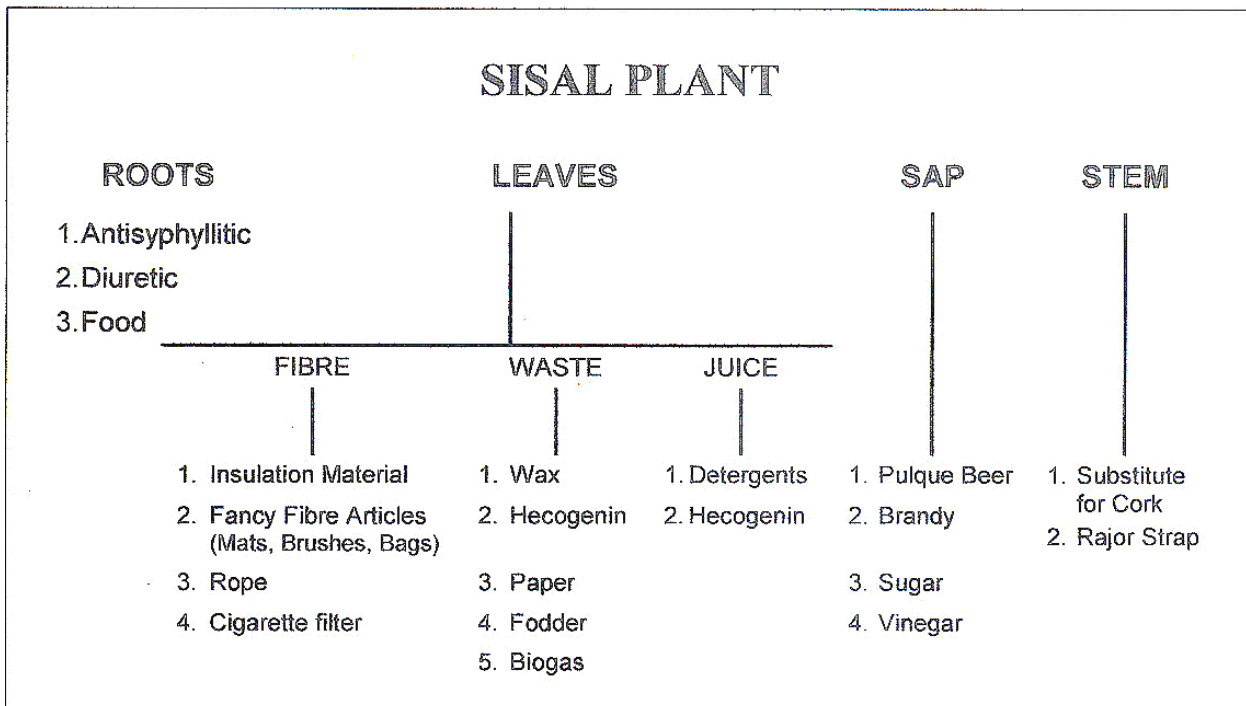
In fermentation, besides yeasts, ethyl alcohol and organic acids, some other products like butanol, butylenes glycol and glycerol are also produced.

The case of chilies is another example. Chilly prices go up and down. If only to stabilise the prices, industries can be set up centering round chilies. The chilies have got four major components: oleo-resin, vitamin C, bactericide, and the hot pungent component. Besides extraction of vitamin C and oleo – resins, chilies could be more readily exported after removing the hot pungent component.

Also industries round cotton and groundnut may be set up.

Forest products like Agave Americana and Annona Squamosa have multiple uses.

**Agave Americana:**



In Brazil a plant for the manufacture of paper with input as sisal agave is in operation. Country liquor called 'Mescal' is made from the leaves of sisal in Mexico. Shirts made from the fibre of sisal agave leaves are manufactured in Philippines under the trade name 'Dip Dry'.

### **Annona Squamosa (Sugar Apple)**

Pulp in the fruit

- on top of ice cream, jelly & jam making
- drinks and in fermented liquors.

The fruit has sizeable number of seeds. The seed yield about 30% oil. The extraction of the oil can be done by the process of solvent extraction.

The oil is used in

- in paints and varnishes
- as natural insecticide.

Annona seed oil contains acetogenins that are toxic to insects.

Annonin, ascimicin, bullatacin, isobullatacin, desacecylucaricin and isodesacetylucaricin have been isolated from the sugar apple seeds and shown to be biologically active against the spotted stem borer, *Chilo partellus* Swin., oriental armyworm, *Mythimna Separate* Wlk., head bugs, *Calocoris augustus* Leth., and the aphid, *Melanaphis sacchari* Zehnt.

Pesticides derived from plants like *Annona Squamosa* can play a major role in pest management in sustainable agriculture. They have renewable character, are non-persistent in the environment, and are relatively safer to the natural enemies, non-target organisms, and human beings.

The *Annona* oil contains the following percentages of acids:

Oleic	:	18.1
Linoleic	:	55.1
Palmitic	:	14.7
Stearic	:	10.7

These acids find use in the preparation of:

Oleic : Soap base, manufacture of oleates, cosmetics, polished compound, lubricants, Ore floatation, organic synthetic intermediate, surface coatings etc.

Linoleic : Soaps, special dryers, for protective coatings, emulsifying agents. medicine, Foods, feeds, and bio-chemical research.

Palmitic : Starting point in the manufacture of various metallic palmitates, soaps, Soaps, lube oils, and water proofing.

Stearic : Chemicals, especially stearates and stearic driers, lubricants, soaps, candles, Pharmaceuticals, and cosmetic rubber compounding, shoe and polishes, coatings and food packaging.

The seed cake after extraction of oil can be used as fertiliser. The nitrogen content of the defatted meal from the sugar apple is in the range of 4.3 %. The epicarp after removal of pulp and seed from the *Annona Squamosa* fruits can be used as green manure. The leaves of the plant are bitter and as such the cattle won't eat them.

## **Water Hyacinth ( *Eichhornia Crassipes* )**

### **Wealth from Waste**

Water hyacinth which is generally regarded as a menace can find many uses:

- in food production
- as leaf protein concentrate, which is rich in protein and vitamin A,
- as a substrate for mushroom cultivation,
- by making soils more fertile which yield better crops,
- by purifying water, in which fish can then thrive,
- through the production of silage, for fattening animals,
- through vermiculture, producing feed for poultry or fish,
- in regenerating degraded soils,
- as mulch
- as compost
- as fertiliser, produced by mixing with other organic materials, and phosphate rock,
- in biogas production. 1 hectare of weed can produce 100 tons of dry water hyacinth/year which could produce 30,000 cu.m of gas sufficient to supply cooking for 40 families. The residual slurry must be used as mulch,
- as briquettes, which can be used for cooking in kitchens for schools and restaurants,

- in providing employment and income, through the production and sale of;
  - a range of art papers and cards
  - crafts and furniture
  - (on industrial level), chemicals and liquid fuels.

### **Nutritious Protein from Water Hyacinth:**

#### Leaf Fractionation:

Leaf fractionation produces up to 10 times as much protein per hectare as when the land is used to grow food for animals. It does not require artificially fixed nitrogen, which is made using a large amount of energy. It is already being used on Lucerne, or alfalfa in France, Hungary and the US to make supplementary feed for pigs and poultry. As Lucerne is a legume, it adds nitrogen to the soil.

The process can be applied to almost any fresh green leaves, including weeds such as water hyacinth and nettles. The leaf protein it produces contains no animal fats, and the fibrous residue is an excellent ruminant food.

Feeding trials in 14 countries have shown that regular leaf concentrate consumption promotes good health and weight gain, increases hemoglobin and vitamin A status, and reduces the frequency and severity of illnesses. One series of trials in which leaf protein was used to supplement the diet of badly nourished children for six months showed that the weight increase was nearly three times as great as that of those whose diet was unaltered (**New Scientist, 5<sup>th</sup> April, 2000**).

Such enterprises, centered round the rural produce/waste as industrial raw material will mean: better use of local

resources; better dispersal of industries; reduced requirements of storage, transport and distribution; utilization of profit- generating low-capital labour-intensive processes; starting a healthy economic chain leading to production of additional capital and more capital and more capital being ploughed into the industries sector from the agriculture sector.

The present pattern of urban-oriented, capital-intensive industrialization has produced severe imbalances in developing countries between the elite groups that monopolise wealth and power and the majority of rural people who are poor. A correction is called for.

It is urged that decentralized rural industrialization, based on the generation and optimal utilization of biomass may well prove to be an alternate pathway for industrialization. Contrary to traditional thinking on cottage and rural industries, the coupling of large, rich, renewable local resource biomass with technological advances, utilizing every part of a plant from "leaf to root" will help maximizing the returns for the resource, provide additional incomes, employment and equity and keep people in the rural areas instead of bringing them to the city slums.

"Development is not development of things but development of people, their inherent resourcefulness and capabilities, resulting in increased employment, productivity and improved income distribution" -- **Prof.Y.Nayudamma.**



Furniture from Water Hyacinth Root



Weed Harvester

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Dr. Anumakonda Jagadeesh obtained his Bachelors and Masters degrees in Physics from [Sri Venkateswara University](#), Tirupati, Andhra Pradesh, India, and his Doctorate degree in Wind Energy from the prestigious University of Roorkee (now the [Indian Institute of Technology Roorkee \(IITR\)](#)). He has been involved in teaching and research for the last 30 years. He founded "Society of Science for the People" in 1973, an NGO which has been acting to formulate innovative science and technology programs and projects. Dr. Jagadeesh widely interacted with several global and national organizations in Science and Technology projects; his programs attracted world wide attention, especially in Appropriate Technology, Afforestation, Renewable Energy, Environment, etc. Dr. Jagadeesh also founded "Nayudamma Centre for Development Alternatives" in Nellore, Andhra Pradesh, India in 1994 which has been acting as a think tank in promoting Energy, Environment, and Appropriate Technology programs and projects. He has been Resource person to several organizations connected with Sustainable Development in India and abroad. Dr. Jagadeesh has traveled to over 30 countries and worked in Italy, Denmark, Sultanate of Oman, etc. He has held many important positions such as Director, Murugappa Chettiar Research Centre, Chennai, India; Vice President, Subhash Projects and Marketing Ltd, Bangalore, India; Director, Infrastructure Consulting and Engineers Pvt. Ltd, Bangalore; and currently Professor and Head, Centre for Energy and Sustainable Resources, R.M.K. Engineering College, Kavaraipettai, Tamil Nadu, India. Dr. Jagadeesh's pioneering work won him several international and national awards including the prestigious "Margaret Noble Foundation, Seattle" Award for Research in Energy. He has membership in several international and government bodies in India. It is rarely one finds an Innovator, social scientist and crusader for the promotion of Science and Technology for Sustainable Development, all blended into one.