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IMPROVEMENT OF RURAL LIVELIHOOD THROUGH BIOTECHNOLOGY

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Figures and typed table should be in separate pages and provided with title and serial numbers. The exact position for the placement of the figures and tables should be marked in the manuscript.

Articles should be sent to

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EDITORIAL

Rural population in India has been facing series of problems which affect their progress and quality of life. Most significant among these problems are lack of gainful employment leading to food insecurity, illiteracy and poor health. Biotechnologies have played an important role in the development of food products over many centuries. In recent years the "modern biotechnologies" of molecular biology and gene technologies have gained a significant role in the cereals sector, sustainable development goals that embody ecological, social, and economic requirements. Applications of modern biotechnology show a significant contribution to sustainable gains in agricultural productivity, reducing poverty, and enhancing food security in developing countries.

There are many Government and Non-Government Agencies engaged in providing sustainable livelihood to the rural poor. Over the years, a large number of activities have been identified both in On-Farm and Non-Farm sectors.

In this newsletter (Vol. no. 28), we have attempted to discuss the **Improvement of rural livelihood through Biotechnology** related issues.

(S. C. Santra)

IN THIS ISSUE:

IMPROVEMENT OF RURAL LIVELIHOOD THROUGH BIOTECHNOLOGY

Abstract

The explosive population growth and climate change are threatening the food security of the country. The requirement of food, energy and water are increasing day by day. To fulfil the future need food and energy from limited resourses can be possible through use of biotechnological tools in agriculture and energy sectors. The use of biotechnological tools may help achieve the productivity gains needed to feed the growing global population through yield increase, introduce of resistance crops to adverse weather, soil, pests and diseases. The new crop varieties develops through biotechnology and biocontrol agents may reduce dependancy on pesticides, reducing cost of farmers' investment and benefiting both the environment and public health. Biotechnology based agriculture combines elements of ecological agriculture with crop varieties designed to perform well under low-input and stress conditions. Research on genetic modification to achieve appropriate pest and weed control can support the farmers. The application of biotechnology in agriculture offers ecofriendly and cost-effective solutions to micronutrient, malnutrition, mineral aborption and vitamin - iron-rich crops.

Like agriculture the biotechnologies tools also applied in fisheries, food production and industry sectors. The sustainable use of natural resources and the need to support the livelihood of rural population of the world the use of scientific biotechnological tools are urgently needed. To face the global challenges of crisis of food & nutrition the alternative methods should be considered using biotechnology like, genetically modified organisms (GMO) and their potential use.

The successful application of relevant biotechnology rural sectors will be a necessity in transforming agriculture besides enhancing the protecting rural livelihoods as rural integrity. In this newsletter, we discused how different biotechnological advancements are necessary for model development of the rural economy, rural health and rural society.

INTRODUCTION

Poverty reduction, food security and agricultural sustainability require that the livelihoods of poor farmers be improved. The potential of biotechnology to improve the livelihoods and agricultural sustainability of farmers has been hotly debated and primarily focused on modern biotechnology. Biotechnology is much broader than this narrow focus and includes "traditional" biotechnologies, as well as, industrial and medical sectors.

Biotechnology is any technique that uses living organisms or substances derived from these organisms to make or modify a product, improve plants or animals or develop microorganisms for specific uses. Modern biotechnology represents unique applications of science that can be used for the betterment of society through development of crops with improved nutritional quality, resistance to pests and diseases, and reduced cost of production.
The key components of modern biotechnology are (Figure 1):

Genomics: The molecular characterization of all species;

Bioinfomatics: The assembly of data from genomic analysis into accessible forms;

Transformation: The introduction of single genes conferring potentially useful traits into plants, livestock, fish and tree species that are then called transgenic or genetically modified organisms;

Molecular Breeding: The identification and evaluation of desirable traits in breeding programs by the use of marker assisted selection;

Diagnostics: The use of molecular characterization to provide more accurate and quicker identification of pathogens;

Vaccine Technology: The use of modern immunology to develop recombinant DNA vaccines for improving control of lethal diseases.

Fig.1 Morden biotechnology
Source: http://slideplayer.com/slide/6318440/

The application of modern biotechnology in advance agriculture shows a significant potential of agricultural biotechnology through sustainable gains in crop productivity, food security, reducing poverty and rural livelihood development. By adopting the advance technology the potential socioeconomic and environmental costs benefits should be critically assessed.

The biotechnology application in rural sectors is the integrated use of microbiology, genetics, biochemistry and engineering sciences of the capabilities of micro-organisms and tissues /cells cultures for rural development (Figure 2). An integrated knowledge of this field is a foot to bring a potential development in the rural population in which an inter relationship is needed as an essential support to the rural people

Different biotechnology types have different effects and these impacts are molded by the macro-economic policies of the countries where they are implemented. Generally, the problems of poor farmers are not technological and the benefits of biotechnology are unlikely to reach poor farmers unless these 'non-technical' problems are addressed first.

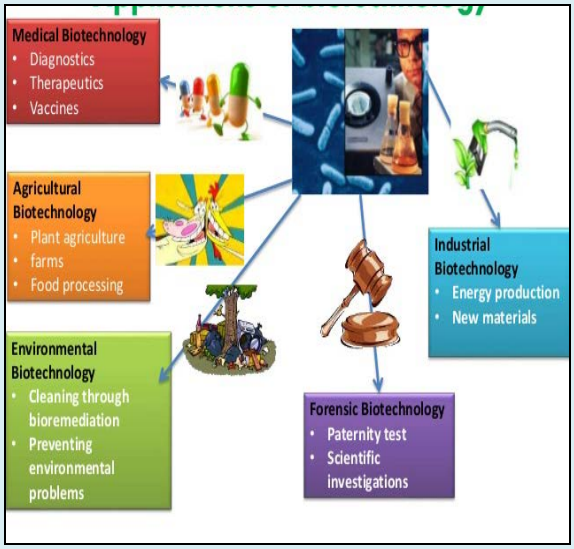

Fig. 2 Application of biotechnology
Source: http://www.slideshare.net/

TCHNOLOGIES FOR RURAL DEVEVELOPMENT

Animal biotechnology

Animal biotechnology has a vast potential to enhance animal productivity through better health management by the use of efficient vaccines, diagnostic agents and hyper immune sera. It is one of the potential tools that may help to ensure the availability of sufficient, safe an affordable food in a socially acceptable and environmentally sustainable manner. Livestock is becoming increasingly important to economic growth in developing countries and the application of biotechnology is largely dictated by commercial considerations and socio-economic goals. India is the third most country in the world to implement this technology. The animal biotechnology improve the live stock productivity and helps in decrease the rural poverty **(Purohit, 1999).**

Selection of superior germ plasm and disseminate it using artificial insemination, embryo transfer and other assisted reproductive technologies is now possible using advance molecular markers technology by identifying and select particular genes. These technologies have been used in the genetic improvement of livestock, particularly in cattle and buffaloes, and the economic returns are

significant. However, morbidity and mortality among animals produced using assisted reproductive technologies lead to high economic losses, so the principal application of animal biotechnology at present is in the production of cheap and dependable diagnostic kits and vaccines(Figure 3).

Fig. 3 Animal Biotechnology
Source: http://www.slideshare.net/

The biotechnologists have developed many products and processes by modern techniques including gene cloning, microprocessor controlled bioreactors, and immobilization. A significant products of recombinant DNA technology is already on the market. 1000 millions dollars of biotechnological agro-products have sold in world. The Bio-products will be emerging out from laboratory to society for use of common people through proper commercialization by appropriate industrialists **(Banerjee et al, 2001**).

There are a significant research and development of recombinant products in India but not commercialised upto mark like western countries for use of the society. The DNA finger printing technology is now a common practice in forensic tests. The outcomes of animal biotechnology are embryo transfers, in vitro fertilization, stem cell culture and transgenic animals (Figure 4). The availability of such advance technology to the common people will promote the rural livelihood in near future.

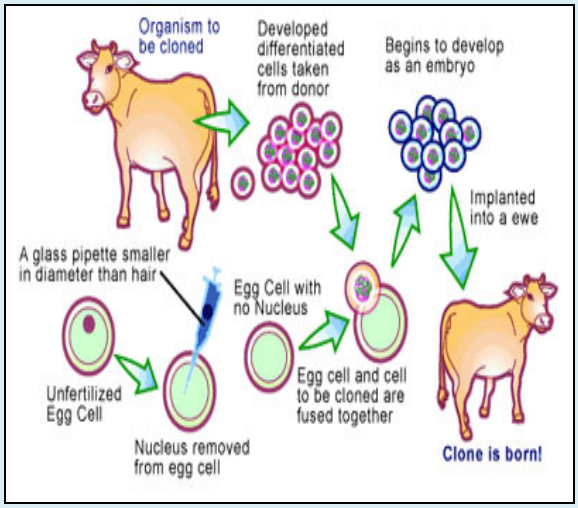

Fig. 4 Transgenic Animals
Source: https://palmer-dna-tech-project2012

Agriculture biotechnology

The application of biotechnology tools in agriculture (Green biotechnology) is necessary to fulfill our future demand on food and nutrient. The use of biotechnology can face the major challenges such as declining per capita availability; lower productivity of crops, livestock and fisheries, heavy production losses due to biotic (insects pests, weeds) and abiotic (salinity, drought, alkalinity) stresses; heavy post harvest crop damage and declining availability of water as an agricultural input. It holds the potential for improving the competitiveness of regional agricultural production in world markets, as well as reducing the incidence of urban and rural poverty. In rural areas, constraints to crop production include pests, diseases, weeds, environmental degradation, soil nutrient depletion, low fertilizer inputs, inadequate food processing amenities, and general lack of information to make science-based decisions. The spectrum of biotechnology application in agriculture is very wide and includes generation of improved crops, animals, plants of agro forestry importance.

It could improve the nutritional value of food crops and expand the potential uses of agricultural processes and products (by utilizing non-edible substances of food crops to produce medicinal products, fuel alcohol, and industrial oil) thereby

increasing the employment and incomes farmer communities. (Figure 5)

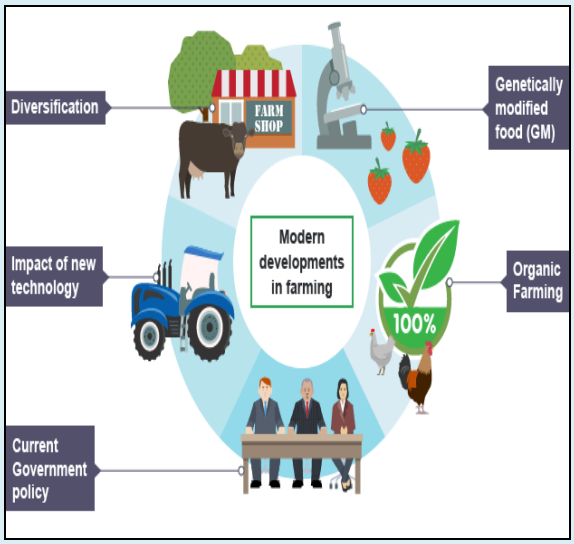

Fig. 5 Modern developments in farming
Source: http://www.bbc.co.uk/

Advances in agricultural biotechnology, which are driven in part by advances in medical biotechnology, are producing a revolution in the knowledge about how plants and animals grow and produce useful products. Genetic maps of major species now have markers for many important genes. For a few plants the complete genomes have been sequenced. At the same time functional genomics is identif ying the role of the plant genes. Functional genomics research is growing rapidly, financed largely by the major agricultural input companies that are hiring medical biotech companies and start up companies from universities to identify genes (Fig 6).

Fig. 6 Creating a Transgenic Crop
Source: http://as.wiley.com/

Industrial biotechnology

Industrial (white) biotechnology have significant services for society. The application of biobased production process that use less energy, less use of non-renewable energy resources and that result in less waste and emissions, it might contribute to a more ecofriendly sustainable economy. Industrial biotechnology uses biological systems (organisms, whole cells or specific enzymes) as reagents or catalysts for cleaner production processes, and to produce biobased feedstock for the chemical and energy industries. In general, industrial biotechnology can, by itself or in conjunction with other (bio) technologies, contribute to more sustainable production in a host of areas in industry. A variety of such new processes and products has already been developed and implemented. The potential of industrial biotechnology is being applied in the following areas.

- ✓ Production of biofuel and usable chemicals from biomass and biowastes.
- ✓ Cleaner industrial process and green chemistry.
- ✓ Preparation of novel materials, biopolymers, nanomaterials, bioactive and optically active molecules. (Figure 7)

Fig. 7 Industrial Biotechnology
Source: http://www.kochmembrane.com/

The knowledge and adaptation of organic farming, like biocomposting, vermicomposting, biopesticide are the desired way to improve the economy of

rural farmer communities and also replace the traditional use of chemical fertilizers. **(Rajak, 2000; Rajini Gupta, and Mukerjee, 2001).**

Bioprocess applications constitute only a relatively small fraction of market for agricultural commodities (**Purohit, 1999).** The requirement of raw materials for bioprocesses is not available sufficiently for largescale application in present situation. Tha application of bioprocess should be encouraged in the areas of fuel or chemical production for various carbohydrate wastes agricultural foods, industrial or household, despite frequent claims of their availability and low cost **(Mukhopadhyay, 2001).** A numerous fermentation products and chemicals manufacturing processes are depended on the use of agricultural commodities **(Chand, and Jain, 1999).**

A mutual interaction should be developed between fermentation industries and farmers to enhance the income of farmers communities by suppling of raw materials (straw, grains, bran, agro-wastes etc.) directly to company. The Central Leather Research Institute at Chennai took initiative to replace the use of chemicals for traditional leather processing through educated low-incoming people by key of organizing programmers through extension and consulting centers. Cellulase free xylanase has commercialized in the view of hand paper mills **(Tripathi, 1999).** The food processing industries have discharged a large quantity of residues as waste. Centre for Food Technological Research Institute (CFTRI), India, has developed many human consuming products including *Spirulina*, *Chlorella*, single cell protein (SCP), single cell oil, mushroom, fermented products and has also developed many convenient processes for development of income in rural people **(Knarr, 1987).** The environmental biotechnologists have guided for proper sanitation, treatment of wastewater and public health in rural sectors **(Agarwal, 1998).** The relationship between the Society-scientists-industry must be buildup to technology transfer, rural health and economy in India (Figure 8).

Fig. 8 Modern biotechnology
Source: http://www.pacontrol.com/

Bio-energy

Bioenergy is the energy derived from biomass to generate electricity and heat or to produce liquid fuels for transport. Organic material containing bioenergy is known as biomass. It is available in many forms such as agricultural products, forestry products, and municipal and other wastes. Human can use this biomass in many different ways, through something as simple as burning wood for heat, or as complex as genetically modifying bacteria to create cellulosic ethanol. Since almost all bioenergy can be traced back to energy from sunlight, bioenergy has the major advantage of being a renewable energy source. Traditionally mainly woody biomass has been used for bioenergy, however more recent technologies have expanded the potential resources to those such as agricultural residues, oilseeds and algae (Figure 9). These advanced bioenergy technologies allow for the sustainable development of the bioenergy industry, without competing with the traditional agricultural industry for land and resources. The following integrated approaches will satisfy development of renewable sources of energy as,

- To carry out field-testing and demonstration of technologies in farmer level.

- Plantation for bio-energy through private enterprises linked to its utilization needs to be promoted
- A low rate short term loans should be made available for production and conversion technologies and equipment.
- Intensive R & D should be supported to commercializing technology under different marketable site conditions.
- Technologies for extension should be developed to support quantum jumps of factors of two or three in one biological cycle.
- Aneffort should be made on biogasification for agro wastes and composting of urban waste.

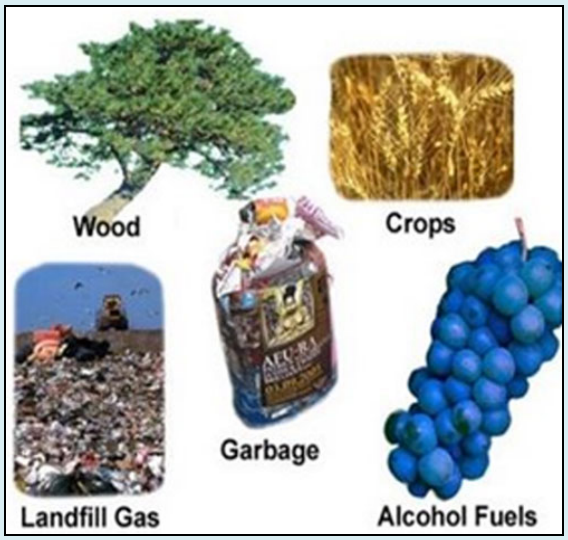

Fig. 9 Renewable Bioenergy
Source: http://www.mgired.kar.nic.in/

Most of the developing nations, including China and India, have plans to double their bio-fuel production within the next 15 years. The most promising crop options and the researchable issues need to be addressed for more efficient **bio-ethanol** and **bio-diesel** production.

Bio-Ethanol

Though sugarcane and corn are the major feed stock currently used for ethanol production, their potential is limited to irrigated (or high rain fall) and well endowed environments. Further, the use of corn for ethanol production compromise with the food security in developing countries. In India, China and other developing countries sugarcane molasses is the main raw material for ethanol production. Sweet sorghum juice is better suited for ethanol production because of its higher content of reducing sugars as compared to other sources including sugarcane juice.

Hybrids Research experience at ICRISAT and elsewhere has shown that hybrids produce relatively higher biomass, mature earlier and are more photoperiod-insensitive compared to open pollinated cultivars under normal as well as abiotic stresses, including water-limited environments. The photoperiod- and temperature-insensitiveness is essential to facilitate plantings at different dates for continuous supply of sweet sorghum stalks to distilleries for ethanol production. The mean performance of selected sweet sorghum hybrids (in a RCBD trial with 3 replications) over two seasons are presented in **Table 1.**

Table: 1 Performance of selected sweet sorghum hybrids at ICRISAT, Patancheru, India

Hybrid	Per day ethanol productivity (l ha^{-1})[a]
ICSA749 × SSV74	18.48
ICSA511 × SSV74	15.39
ICSA474 × SSV74	17.13
SSV84 (control)	10.50
NSSH104 (control)	10.74

[a] Ethanol productivity estimated at 40 liters per ton of millable cane yield.

Bio-Diesel

Biodiesel in India is mostly produced from the non-edible oil seeds plants like Jatropha (*Jatropha curcas*), Karanja (*Pongamia pinnata*), Neem(*Azadirachta indica*) and Mahua(*Madhuca indica*) etc.

Jatropha *(Jatropha curcas)* is a drought-resistant perennial, growing well in marginal/poor soil. It is easy to establish, grows relatively quickly and lives, producing seeds for 50 years. Jatropha plant produces seeds with an oil content of 37%. The oil can be combusted as fuel without being refined. It burns with clear smoke-free flame, tested successfully as

fuel for simple diesel engine. Jatropha can be used for bio-energy to replace petrol-diesel and lubricant. It has applications as medicine, for soap production and climatic protections. Recently Jatropha is being considered as one of the most promising potential oil source to produce biodiesel in Asia, Europe and Africa.

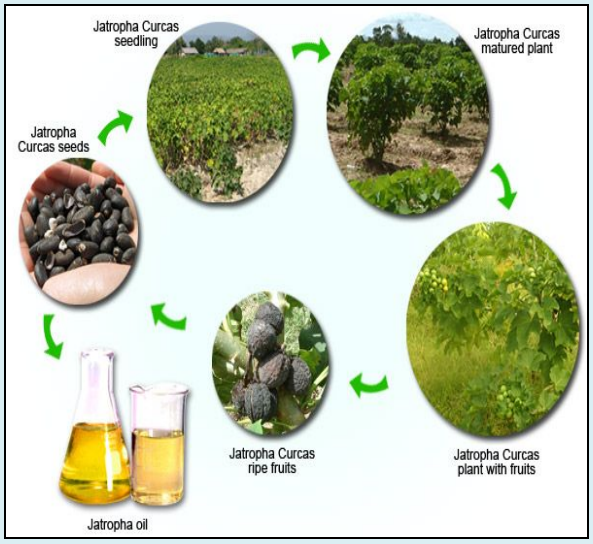

Fig. 10 Jatropha Life Cycle
Source: http://www.shirkebiofuels.com/

Karanja *(Pongamia pinnata)* is a medium sized tree is found almost throughout India. Karanja tree is wonderful tree almost like neem tree. It can be propagated either by seeds or by root suckers. Pongamia can survive in adverse conditions like draught, heat, frost, salinity etc.

Fig. 11 *Pongamia pinnata*
Source: http://www.tradeindia.com/

Most of the physical and chemical properties of the directly extracted oil are almost similar to those of the diesel, though ‘‘conardson carbon” residue is higher in case of it and due to high viscosity preheating is necessary to start a diesel engine. The toxic substances present in the oil limits its use as cooking oil. However, as for other oils there are limitations in the use of this nonedible oil as fuel. Its high viscosity and poor combustion characteristics can cause poor atomization, fuel injector blockage, excessive engine deposit and engine oil contamination (Figure 11).

Neem (*Azadirachta indica*) is a tree in the family ‘Meliaceae’ which grows various parts in India. Neem oil is generally light to dark brown, bitter and has a strong odor that is said to combine the odors of peanut and garlic. Neem comprises mainly of triglycerides and large amounts of triterpenoid compounds. It contains four significant saturated fatty acids, of which two are palmitic acid and two are stearic acid. It also contains polyunsaturated fatty acids such as oleic acid and linoleic acids

Mahua (*Madhuca indica*) tree, which is a medium to large tree found in most parts of India. Mahua oil is obtained from the kernel of mahua tree (*Madhuca indica*), which is a medium to large tree found in most parts of India. The unrefined but filtered crude mahua oil is greenish yellow in colour. The unrefined but filtered crude mahua oil is greenish yellow in colour. Mahua has an estimated annual production potential of 181 thousand metric tonnes in India.

At present a large number of jatropha and pongamia accessions are being collected by various research organizations in India under bio-diesel network programs funded by the Department of Biotechnology and National Oilseeds and Vegetable Oils Development Board. The collections are being characterized for their oil content and fatty acid composition by ICRISAT, The Energy Research Institute (TERI), and other institutions in India. Seed oil content ranges from 28%to 40%in jatropha and pongamia accessions that are being maintained and characterized at ICRISAT.

The appropriate kind of planting material (vegetative propagation/tissue culture seedlings) need to be therefore standardized, to ensure the true breeding nature of the best clone to be identified or developed through concerted research efforts (Figure 12).

Fig. 12 Major Bio-diseal crops and their Uses

Biodiseal form Algae

Further, the poor yields of non-edible oils make it inadequate to fulfill the country's energy demand. As a result, microalgae is in focus as a future source of biodiesel due to the advantages of yielding 30 times more oil compared to other oil seed crops. There are significant level of oil content found in several microalgae **(Table 2).**

The best algae for biodiesel would be microalgae and are the highest yielding feedstock for biodiesel and it can produce up to 250 times the amount of oil per acre as soybeans. It is one of the best sources of biodiesel. Photosynthetic organisms that grow in aquatic environments include macroalgae, microalgae and emergents. While the mechanism of photosynthesis in microalgae is similar to that of higher plants, they are generally more efficient converters of solar energy because of their simple cellular structure. In addition, because the cells grow in aqueous suspension, they have more efficient access to water, CO_2, and other nutrients. For these reasons, microalgae are capable of producing 30 times the amount of oil per unit area of land, compared to terrestrial oilseed crops (Figure13).

Table: 2 Oil content of microalgae.

Microalgae	Oil content (% dry wt)
Botryococcus braunii	25–75
Chlorella sp.	28–32
Crypthecodinium cohnii	20
Cylindrotheca sp.	16–37
Dunaliella primolecta	23
Isochrysis sp.	25–33
Monallanthus salina	>20
Nannochloris sp.	20–35
Nannochloropsis sp.	31–68
Neochloris oleoabundans	35–54
Nitzschia sp.	45–47
Phaeodactylum tricornutum	20–30
Schizochytrium sp.	50–77
Tetraselmis suecica	15–23

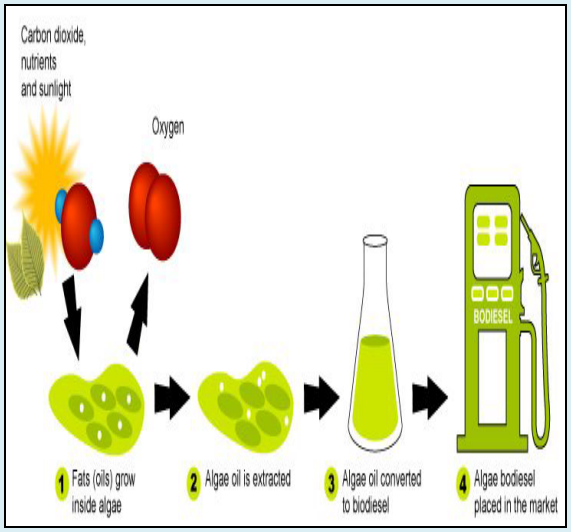

Fig. 13 Biodiesel Processing form algae
Source: https://lawofalgae.wiki.zoho.com

Biogas

Biogas is the gas produced after anaerobic digestion of organic matter by micro-organisms. The biogas is in use since long time in India but the technology improvement is necessary in order to improve energy outputs. It can be produced either from biodegradable waste materials or by the use of energy crops fed into anaerobic digester to supplement gas yields. The solid by-product can be used as a Bio-Fuel or a fertilizer. It creates energy from municipal organic waste and solves the concern of waste disposal and hygiene. Biogas is an already established bioenergy component of India. Presently it is

estimated to contribute to 0.6% of the total bioenergy production in the country. But it has the potential to contribute up to 9% of bioenergy production even now. Rural farmland cattle and poultry waste, food waste and pressmud have been accounted for the projection of energy production from biogas. Presently 4.31 million family-type biogas plants have been reported to have been set up in the country against an estimated potential of 12 million plants, to recover energy from cattle and poultry waste. While technically biogas can be produced from any type of organic material, most times, biogas is produced from organic waste. This waste could comprise agricultural and crop waste, human waste and animal waste (cow dung for instance). With a calorific value of about 5000 kilo Cal / m^3, biogas is an excellent fuel for heating purposes as well as for generating electricity (Figure. 14).

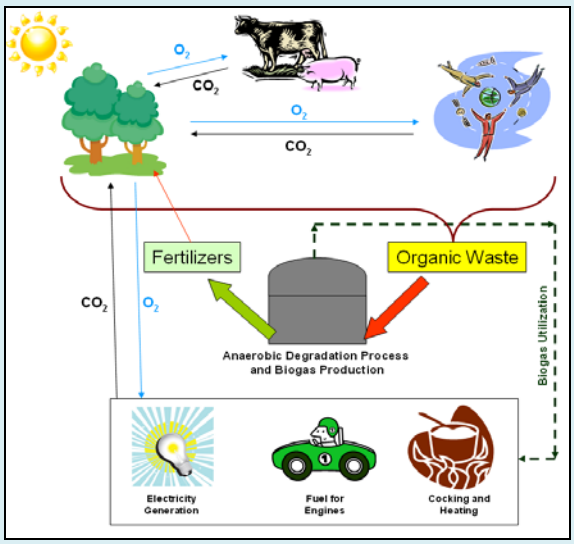

Fig. 14 Production of energy from Biogas.
Source: Gauri P. Minde *et. al.*, 2013

Marine bioresourece

Marine bioresource offer a variety of crucial benefits and services to common man. But increasing human activities threaten the sustained use and delivery of these ecosystem services. According to Millennium Ecosystem Assessment, 2003 marine ecosystem services can be sectioned to four types *viz.*, provisioning, regulating, supporting, and cultural. Provisioning marine service provide a wide ,verity of food a resources through capture fisheries, aquaculture, alternative energy, pharmaceutical and natural products.

The services obtained from these resources counts from the tangible resources such as fishery which serves the livelihood of billions of people around the world to intangible services such as those of aesthetic value. The agribusiness opportunities of marine ornamental fish farming can be realized at every stage of activities, namely, at production, marketing and also taking active participation in conservation of ornamental fishes. With the initiatives by the Govt. such as providing incentive to establish ornamental fish production unit, considerable private investment can be attracted to this industry, which would create additional employment opportunities.

Adequate transfer of technology to the local people on the ornamental value of uncustomary bioresources, their conservation status, their captive breeding and farming techniques are important. In this context, it is essential to take some measures to educate all the stakeholders in this field for the sustainable growth of this industry (Figure15).

Fig. 15 Marine resources
Source: http://www.canstockphoto.com/

Seaweed mariculture is an important and profitable livelihood option for the coastal fishing community especially for fisherwomen, who with little effort can earn a substantial income for the household. In India, traditionally,

seaweeds have been collected from natural stocks. However, the need for farming of seaweeds arose from the unsustainable harvesting of the seaweeds and the increasing demand for high quality and adequate quantity of seaweed raw material from the seaweed processing industries. Accordingly the Central Marine Fisheries Research Institute (CMFRI), the Central Salt and Marine Chemicals Research Institute (CSMCRI) and related organizations began the experimental cultivation of agar-yielding seaweeds Gelidiella in 1964 for developing suitable technologies for the commercial-scale cultivation of raw material to the agar industries.

CASE STUDY

Jatropha biodiseal for Electrification

The Ranidehra rural village electrification initiative of Winrock International India (WII) is to electrify a remote tribal village through the use of biofuel in the state of Chhattisgarh. The objective of this initiative is to demonstrate the technical and financial viability of running diesel generation sets using vegetable oil as fuel in place of conventional diesel to provide electricity. The initiative aims to design and implement a replicable model of remote village electrification via use of Jatropha as feedstock. The experiments undertaken in WII proved the use of Jatropha oil in conventional diesel engines as fuel instead of converting into Biodiesel. In the predominantly tribal village 110 households are accessing 3 hours of domestic and 3.5 hours of street lighting per night using 1 tonne of Jatropha seed per month. The project continues to evolve over time with weaker elements being addressed and improvements made. The initiative establishes the idea of rural electrification through active community participation. The promotion of small scale village energy generation helps to boost the village economy by providing alternative livelihood opportunities.

Source: Final report, January 2009, Prepared for PISCES and FAO by Practical Action Consulting.

Biodiesel for Waterpumping

The biodiesel-based water pumping project is being implemented in the remote and tribal belts of two neighbouring Ganjam and Gajapati districts in Eastern Orissa. This initiative led by CTxGreEn, a Canadian not-for-profit organisation, and Gram Vikas one of the largest NGOs in the state of Orissa, India, involves biodiesel-based water pumping primarily for sanitation in 4 villages. This was later extended into critical irrigation of crops through a bioenergy system that eventually led to regeneration of land resources and improved livelihood opportunities. A biodiesel production unit uses the local underutilised seeds of Pongamia pinñata, Madhuca indiaca from Forest and Guizotia abyssinica (Niger) as feedstock. Biodiesel is produced using a pedal powered reactor for grinding oil seeds, pressing oil from seeds and getting biodiesel from the oil. The biodiesel can be used in the regular pump-sets and generator sets. The press is hand operated while the grinder and biodiesel reactors are pedal operated. The local community uses the by-products, such as pressed oil cake and glycerine, as natural fertilizers and cattle/poultry feed. Although this project is successful on a small scale, and has established the technical feasibility, there is concern that fragile village level institutions, vested political interest, and the absence of strong local level governance could prove to be challenging on a larger scale, particularly as the technology lends itself to enabling social change.

Source: Final report, January 2009, Prepared for PISCES and FAO by Practical Action Consulting.

Mushroom Cultivation in Kashmir valley

A total of 30 women farmers from Aarigam village of Budgam district in Kashmir valley were trained on mushroom cultivation and another 30 educated women were trained on production of pure and disease free mushroom spawn. The women trainees benefitted both in terms of income generation and also skill development to start their own enterprise (Figure 16).

In another project supported at Bangalore, nearly 300 women were trained on Mushroom Cultivation and majority of the beneficiaries (61.76%) could earn an income ranging between Rs 1512 – 2734 in four cycles of 25 bags each in a month.
Source: DBT Annual report 2014-15

Fig: 16 Empowerment of women through mushroom cultivation
Source: http://www.iihr.res.in/

Production & Use of Biocontrol agents in Ajmer

In a project at Bangalore around 1000 women farmers were imparted training on production of bio-agent and mycorrhiza colonized seedlings of horticultural crops in the shade net, nursery beds and in the open field conditions. A seedling production unit at Gorremadugu village of Shidlaghatta taluk of Karnataka has also been established.

Around 84 women farmers from Ajmer district of Rajasthan were trained on use and preparation of *Trichoderma* for seed treatment, *Trichoderma* enriched FYM for soil application and various neem formulation for pest control. Farmers trained under the project were able to locally produce neem based formulation for pest control and save appximately 3000 rupees /acre for pest control products generally purchased from market. A farmers training bulletin was developed under the project having pictorial identification of pests and diseases of seed spices and their management. It was distributed among the beneficiaries of the project.
Source: DBT Annual report 2014-15

Public good research to the rescue of resource poor cotton farmers

In Chennai, the Central Institute for Cotton Research (CICR) of ICAR, Nagpur has come out with a cotton variety which is ideally suited for small farmers with limited coping capacity in case of crop failure. The new cotton variety has triple strengths namely, crop duration is reduced to 150 days from 200 days, secondly, there will be increased yield because of the opportunity for growing more plants per sq.mtr and thirdly, farmers can keep their own seeds unlike in the case of hybrids where they have to buy seeds every year. The CICR has in the breeders' assembly line about 21 high yielding pest resistant cotton varieties suitable for cultivation in Maharashtra and Telengana (Figure 17).

Fig: 17 Cotton field in rural area
Source: http://www.mssrf.org

Livelihood supported agencies in India

M.S. Swaminathan Research Foundation (MSSRF)

The M. S. Swaminathan Research Foundation (MSSRF) aims to accelerate use of modern science for agricultural and rural development for development and dissemination of technology to improve lives and livelihoods of tribal and rural communities. MSSRF follows a pro-poor, pro-women and pro-nature approach and applies appropriate science and technology options to address practical problems faced by rural populations in agriculture, food and nutrition. These efforts have been undertaken in a participatory manner and in partnership with other knowledge-based institutions, public and private sector

organisations and local communities (Figure 18).

From a small beginning, across the years, the Foundation has made its impact felt in various dimensions making a difference to the lives of over 600,000 individuals, impacting livelihood of 100,000 farmers and fisherfolk every day with influence that spreads across 18 countries (http://www.mssrf.org/).

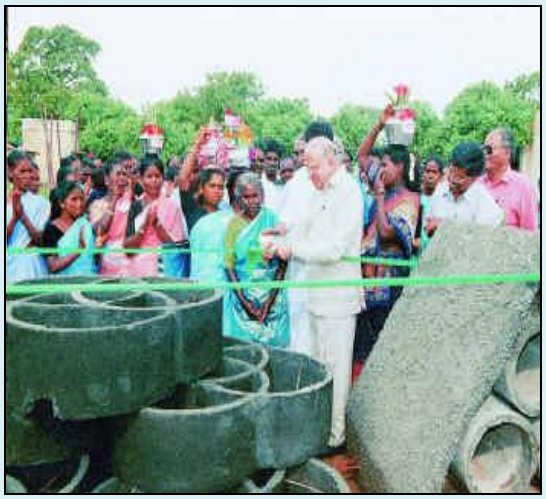

Fig: 18 M. S. Swaminathan inaugurates the Sustainable livelihood development project
Source: http://www.frontline.in/

National Bank for Agriculture and Rural Development(NABARD).

NABARD, aims at acquiring new insights into the problems of agricultural and rural development through in-depth studies and applied research and trying out innovative approaches backed up by technical and economic studies. The R&D Fund is utilised for formulating policies on matters of importance to agricultural operations and rural development, including facilities for training, dissemination of information and promotion of research by undertaking techno-economic studies and other surveys in the fields of agriculture, rural banking and rural development.

Agri Biotech Foundation (ABF)

The Agri Biotech Foundation (ABF) aims at promoting application of agri-biotechnologies for sustainable development. It has well equipped molecular biology lab, growth chambers, bio-safety poly house, transgenic glass house, conference and class rooms, library and staff rooms and uninterrupted power supply system. It undertakes research mainly in molecular biology, tissue culture and microbiology. It organizes both short term and long term training programmes for improving skills among young scientists engaged in plant biotechnologies.
Source:http://www.abfindia.org

District Rural Development Agency (DRDA)

District Rural Development Agency (DRDA) is an Agency to implement Centrally sponsored Schemes of Ministry of Rural Development, Government of India, set up under Society Registration Act 1860. It has traditionally been the principal organ at the district level to oversee the implementation of anti-poverty programmes of the Ministry of Rural Development. This agency was created originally to implement the Integrated Rural Development Programme (IRDP). Subsequently the DRDAs were entrusted with number of programmes of both state and central governments. This aims at strengthening the DRDAs and make them more professional in managing the anti-poverty programmes and be an effective link between the ministry and the district level. Rural Poverty alleviation is the mandate of the DRDA. Gram Swaraj , the dream of the Father of Nation is the vision of DRDA(http://drda.puducherry.gov.in/).

Bharat Rural Livelihoods Foundation (BRLF).

Government of India has setup Bharat Rural Livelihoods Foundation (BRLF) as an independent organization under the Societies Registration Act to facilitate and upscale civil society action in partnership with – Government for transforming livelihoods and lives of rural households, with an emphasis on tribal communities and women and to build capacity of Rural Livelihood Professionals. It is an independent society set up by the Government of India to upscale civil society action in partnership with Government, invites proposals from prospective partner organizations.
The geographical focus of the proposals should be the central Indian tribal belt in

the states of Odisha, Jharkhand, West Bengal, Chhattisgarh, Madhya Pradesh, Andhra Pradesh, Telangana, Maharashtra, Rajasthan and Gujarat. . Proposals must be for projects to be implemented in these blocks, which have more than 20% Scheduled Tribe population.

More:https://www.brlf.in

CONSTRAINTS TECHNOLOGY APPLICATION

- Absence of an accurate and complete database on livestock and animal owners.
- The biodiversity present within species and breeds in agro-ecological systems.
- Models of biotechnological intervention differ distinctly between developed and developing economies
- Many animal species and breeds are unique to the developing world; each has its own distinct developmental, production, disease resistance and nutrient utilisation characteristics
- The lack of trained scientists, technicians and fieldworkers to develop and apply the technologies, both in the government and in the private sectors
- Absence of an interface between industry, universities and institutions, which is necessary to translate technologies into products
- Inability to access technologies from the developed world at an affordable price in order to make a rightful, positive and sustainable contribution to livestock production and the economic welfare of farmers
- High cost of technological inputs such as materials, biologicals and equipment.
- Failure to address issues of biosafety and to conduct risk analyses of new biologicals, gene products, transgenics and modified food items, and, above all
- Several obstacles limit the application of biotechnology at present: there is a lack of infrastructure and insufficient manpower, so funding is needed if resource-poor farmers are to benefit from biotechnology

CONCLUSION:

Biotechnology is a currently emerging field in the world, and it has exploited for various kinds of human consuming products include food products, therapeutics, vaccines, transgenic animals and plants. Moreover, an integrated biotechnological approach will be helpful for improving socio-economic status of rural community in India. Thus, biotechnology has potential effect on virtually all domains of human welfare, ranging from food processing, environmental protection, to human health. As a result, it now plays an important role in employment, productivity, trade, economy and the quality of human health in rural sectors.

REFERENCE:

Banerjee, R, Mukerjee, G, Pandey, A and Sabu, A. 2001. Developments biotechnology: An overview. Indian Journal of Biotechnology, 1:9-16.

Purohit, S. S. 1999. Agricultural biotechnology, AgroBotanica, New Delhi.

Rajak, R. C. 2000. Microbial biotechnology for sustainable development and productivit y. Scient ific Publishers, Jodhpur.

Rajini Gupta and Mukerjee, K. G. 2001. Microbial technology. APH Publishing Corporation, New Delhi.

Mukhopadhyay, S. S. 2001. Process Biotechnology Fundamentals. Viva Books Pvt Ltd, New Delhi.

Chand and Jain, S. S. 1999. Fermentation biotechnology. All India Biotech Association and Department of Biotechnology, New Delhi.

Tripathi, G. 1999. Enzyme biotechnology. Techno Science Publishers, Jaipur.

Knarr. 1987. Food biotechnology. Marcel Dekker, Inc. New York.

Agarwal, S. K. 1998. Environmental Biotechnology. APH Publishing Corporation, New Delhi.

FORTHCOMING EVENTS		
Events	**Date**	**Place & Correspondence**
2016 2nd International Conference on Advances in Environment Research (ICAER 2016)	7-9th July, 2016	Shanghai, China http://www.icaer.org/
International Congress on Water, Waste and Energy Management (EWWM)	18-20th July, 2016	Rome, Italy http://www.waterwaste.skconferences.com/
2016 7th International Conference on Environmental Engineering and Applications (ICEEA 2016)	18-20th July, 2016	Kuala Lumpur, Malaysia http://www.iceea.org/
2016 6th International Conference on Environmental and Agriculture Engineering (ICEAE 2016)	14-16th , Aug 2016	http://www.iceae.org/ Porto, Portugal
2016 6th International Conference on Environment and BioScience (ICEBS 2016)	12-14th Oct, 2016	Incheon, Korea http://www.icebs.org/
2016 4th International Conference on Agriculture and Biotechnology(ICABT 2016)	12-14th Nov, 2016	Taipei, Taiwan http://www.icabt.org/

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