THE STATE EXPERIENCES
The Gujarat Experience
Sustainable Agricultural Development

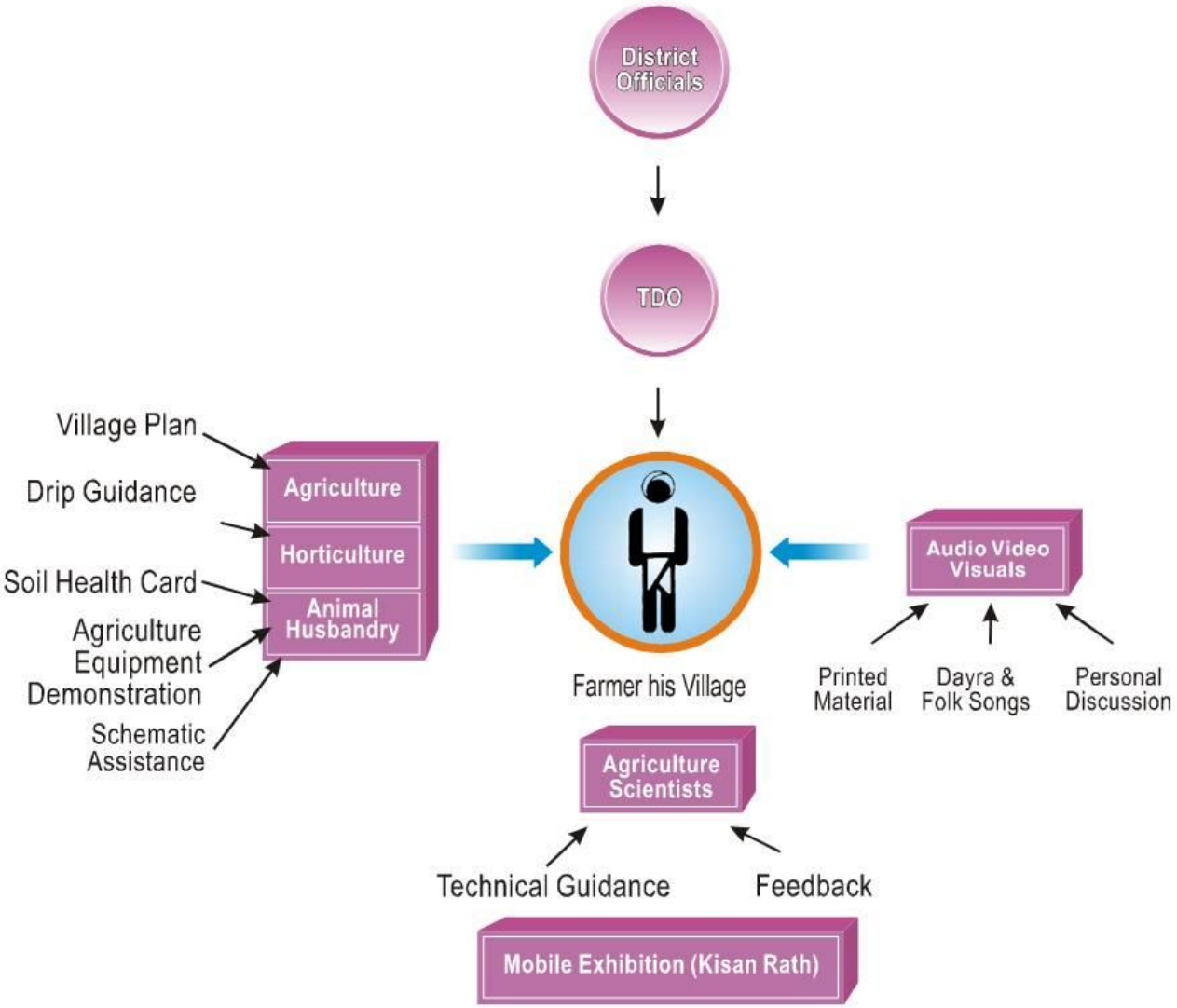
- **Gujarat province of India is one of the progressive states of the Country.**
- **State has all possible handicaps faced by agriculture such as 70% of agriculture being rain-fed, advancement of desert, salinity ingress, under ground water table going down, recurrent droughts, untimely/irregular rainfall and some areas receiving rain only three to four days in a year. Gujarat's agriculture suffered heavily due to droughts.**
- **The growth rate of agriculture used to be negative during such years.**
- **In a normal year, the agricultural growth rate used to be 2 to 3%. Agriculture was not sustainable in many parts of the state due to recurrent crop failures. However, this is a story of the last millennium.**

The Gujarat Experience
Sustainable Agricultural Development

- In the new millennium, Gujarat, with determination and persistent efforts, changed the agriculture scenario.
- From 2004 agriculture witnessed a major turnaround with a growth of 9% per annum.
- The key to this success was public leadership both elected and non-elected, which introduced effective soil and water management and proper land use practices by using mass communication approach-based on a micro level management model.
- On the water front, more than 100,000 check dams were constructed. In the last decade, the numbers of check dams were only 6000

NEW EXTENSION APPROACH - 2

EXTENSION



The Gujarat Experience
Sustainable Agricultural Development

- **It inter-linked rivers such as Mahi and Sabarmati. These rivers, in turn, were linked with Narmada and Mahi canals.**

- **Scientific agriculture was introduced by distributing Soil Health Card to every farmer. From 2004 onwards, 50 farmers from each village were given such cards every year.**
- **The farmers were provided cards with not only soil health analysis, but also soil moisture analysis and past five year's average market price of the crop grown in their area.**

- **This helped them in making an informed choice in the selection of crops. Farmers now sowed crops which gave them higher return and were sustainable in own farms.**

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The Gujarat Experience
Sustainable Agricultural Development

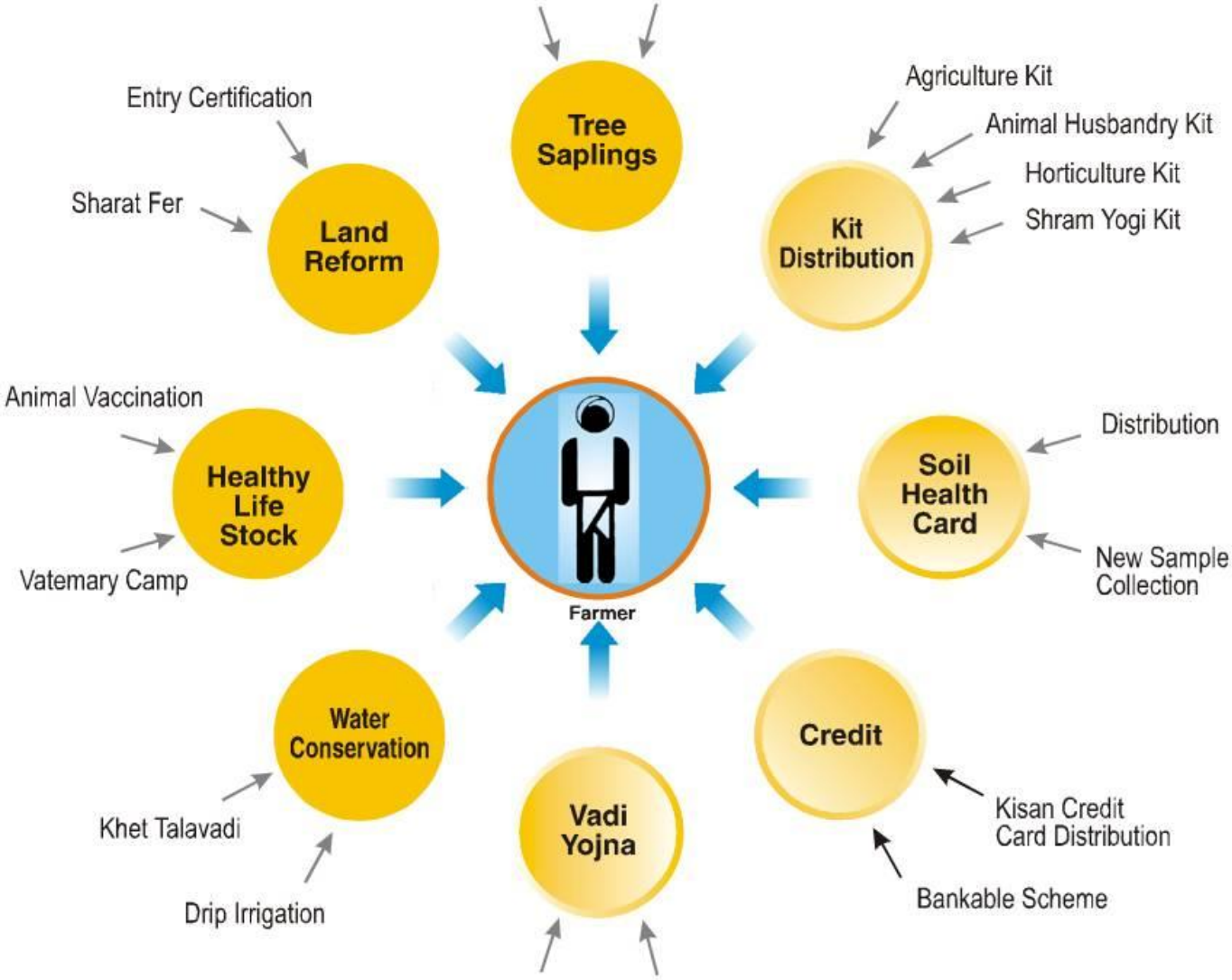
- **A direct door-to-door extension programme for guiding the farmers at village level was introduced under a pre-Kharif programme, known as :Kirishi Mahotsav'.**

- **Every village was visited by a development team comprising agri-scientists and officers from the veterinary department, co-operative, irrigation department, rural development department and local banks etc. High-yield crops were identified.**

- **The farmers were guided about using certified seeds and looking at price of APMCs before selling their farm produce.**

- **BISAG, a institute set up in collaboration with Space Application Centre (SAC), Ahmedabad, by the Government of Gujarat, prepared a micro-level plan for land use by identifying sites for check dams and village ponds for every village.**

NEW EXTENSION APPROACH - 1
FARMERS AS CENTRE POINT



The Gujarat Experience
Sustainable Agricultural Development

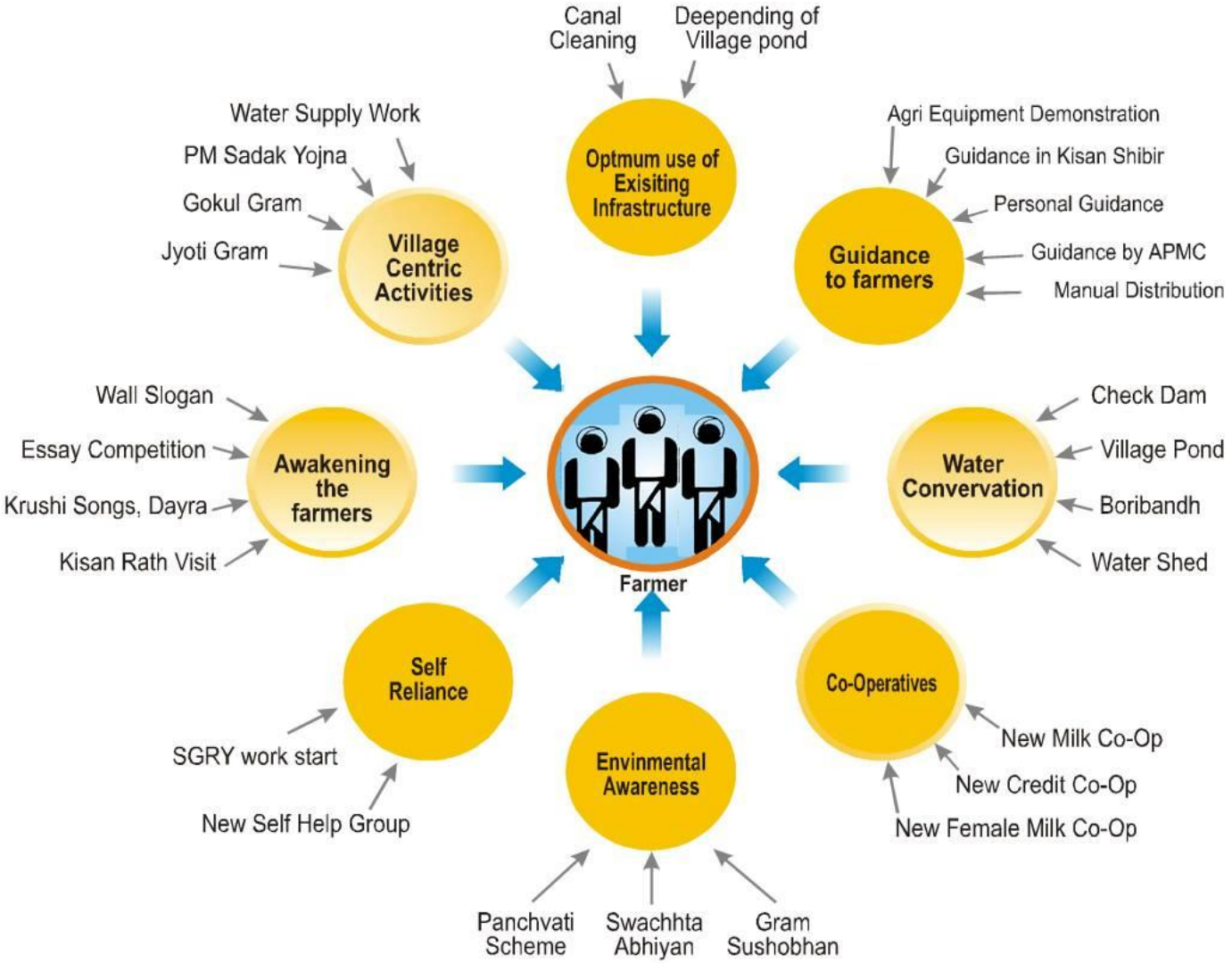
- **ICT material was made available to the farmers in their mother tongue for crop management, including use of fertilizers and pesticides.**

- **Free telephonic help lines were introduced to answer the queries of farmers.**

- **All these initiatives were backed by total involvement of public leadership, both elected and non-elected. From the Chief Minister to the village Sarpanch, from the Chief Secretary to the village level worker, from voluntary agencies, input dealers and co-operatives to bankers – every single individual was involved in the projects.**

NEW EXTENSION APPROACH - 3

FARMERS IN CENTRE



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THE PATH AHEAD

These are stories - real life stories of success of very small people in remote villages of our country. Normally, when we talk about "success', we look at people in high echelons of the society and their achievements - The President or Prime Minister of the country, the CEOs of multinationals or large industrial organizations so on and so forth. We identify their good qualities, the way they have grown and become successful and their efforts they made to reach at top. We suggest to future generations, to follow their examples. This is certainly a need of time to prepare the future generation. But we need to remember that the majority of our people are at the grass root level, in the rural areas. They have wide range of problems despite sixty years of development. There is dissatisfaction among rural youth, their aspirations are not met with. Villages do not have infrastructure and people face all odds including added difficulties of the adverse climate conditions. Not withstanding this, we have many stories of success of people at the village level. Where the major challenge of sustainable livelihood met with successfully. There are achievers, the individuals like Desharbhai and his wife, Vikramsinh Jadeja, Hasabhai, house wives, village committees, Sarpanches - all have quality of leadership as described earlier. What is needed is to ignite their leadership qualities to face challenges and that is what Ngo Shri kantisen Shroff did in Kutch and others have done in different parts of our country.

Contd ….

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THE PATH AHEAD

- The villages of Kutch & Dahod had several adversities, but they were turned around by local people and their leaders with convergence of efforts with government officials and programmes clubbed by dedicated voluntary agencies and local officials of development administration.
- Gujarat story of developing sustainable agriculture is an extension of this, for all its 18000 villages of the State. Normally, there is criticism that when we talk about "a success story" that it is a well implemented programme at one place by some agency and that it is not replicated all over. It is an exhibition piece. But Gujarat - had - all adverse climate conditions - recurrent drought - erratic rain fall - cyclone, soil erosion - increase of salinity, water table going down, frequent failure of crops and negative agriculture growth, soon and so forth, all that is predicated to happen due to adverse impact of global warming.

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THE PATH AHEAD

- In Gujarat, the public leadership, elected and non-elected members of Public Governance System worked together with all the stakeholders for making its agriculture sustainable in last few years. The key to its success is the policy of its leaders who learn from success stories from its own villages like that of Shroff experience and govt's own programmes and research by its Agricultural University's Scientist, to covert it into an Implementable programme with participation of all and got implemented well at all level. This is a remarkable example where the leaders decided and joined to make sure things happen, everybody joined together and made it happen. If this can take place in Gujarat, why not in all the states?.
- A similar approach is needed today by countries, to meeting the challenge of providing sustainable livelihood or for that matter, meeting the challenges of adverse impact of Global Warming. It is the national leadership, which has to go down at grass root level to villages and efforts should happen in all the villages of a nation, with full involvement of State level leadership, district leadership, taluka leadership with people and their leaders at the village level.

Contd ….

THE PATH AHEAD

- India has an example of doing this, under IRDP (Integrated Rural Development Programme) which was introduced in late seventies and early eighties. This programme had focused its approaches on the individual rural poor family and their need to grow economically was met with by convergence of efforts of government, financial institutions and voluntary agencies. This brought about a massive reduction in rural poverty in our country, which is a significant achievement. But still there are poor families - about 20% which have some handicaps and have been left out of development process. They need focused attention. If agriculture can be brought back into centre stage of development policy with focus on individual farmer, probably all these areas and people can be enabled to achieve sustainable development. This will generate simultaneously viable solutions to tackle challenges of Global Warming and for that matter, meet challenges due to social unrest including Naxalists, Maoist, etc. This will also provide opportunities of becoming both future and present generation and lay a path sustain such efforts on a long term basis.

THE KNOWLEDGE ECONOMY

- Application of knowledge is the key to bring about rapid growth and to usher in sustainable development Says Prof. Mukul Asher, Professor of Public Policy, National University of Singapore.

- The term knowledge Economy (KE) reflects importance of knowledge for development process. It involves countries, organizations and people to acquire, create, disseminate and use knowledge more effectively for greater economic and social development.

- It includes application of successful technology of one field to another field.

THE KNOWLEDGE ECONOMY cont…

- It requires transfer of Knowledge Economy from Advanced Countries who are generating most of this knowledge to developing countries, which need it because of their limited awareness, poor economic condition and weak institutions.

- The knowledge revolution has a major role to play in the meeting challenge of global warming and development of agriculture and through that sustainable development.

USE OF AGRO ECONOLOGY AND BIO-DIVERSITY TO MEET THE CHALLENGE OF CLIMATE CHANGE

Dr. Olivier De Schutter "Special Rapporteur on The Right to Food"

The special Rapporteur on right to food presented on 19th December 2010 to UN General Assembly. Some of the important extracts are as under:

Agroecology is both a science and a set of practices of the convergence of agronomy and ecology. It seeks to enhance agricultural systems by mimicking natural processes, thus creating beneficial biological interactions and synergies among the components of the agroecosystems.

Agroecology raises productivity at field level where in

- **Many techniques have been developed and successfully tested.**
- **These approaches involve the maintenance or introduction of agricultural biodiversity (diversity of crops, livestock, agroforestry, fish, pollinations, insects, soil biota and other components that occur in and around production system) to achieve the desired results in production and sustainability.**

Contd….

USE OF AGRO ECONOLOGY AND BIO-DIVERSITY TO MEET THE CHALLENGE OF CLIMATE CHANGE

Some of the successful experiences are:

- A recent sustainable agriculture projects in 57 poor countries covering 37 million hectare (3 percent of the cultivated area in developing countries). Such interventions increased productivity on 1`2.8 millions farms, with an average crop increase of 79 percent, while improving the supply of critical environmental services.

- Following Hurricane Mitch in Nicaragua the experiment demonstrated that farming plots cropped with simple agro ecological methods (including rock bunds or dikes, green manure, crop rotation and the incorporation of stubble ditches, terraces, barriers, mulch, legumes, trees plowing parallel to the slope, no-burn, live fences, and zero-tillage) had on average 40 percent more topsoil, higher field moisture, less erosion and lower economic losses than control plots on conventional farms. On an average, agro-ecological plots lost 18 percent less arable land to landslides than conventional plots and had 69 percent less gully erosion compared to conventional farms.

Contd …..

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USE OF AGRO ECONOLOGY AND BIO-DIVERSITY TO MEET THE CHALLENGE OF CLIMATE CHANGE

- The agro-forestry programme developed in Malawi protected farmers from crop failure after droughts, thanks to the improved soil filtration it allowed. Farm experiments in Ethiopia, India and the Netherlands have demonstrated that the physical properties of soils on organic farms improved the drought resistance of crops".

- Agro-ecology also puts agriculture on the path of sustainability by delinking food production from the reliance on fossil energy (oil and gas). It contributes to mitigating climate change impacts both by increasing carbon sinks in soil organic matter and above ground biomass, and by avoiding carbon dioxide or other greenhouses gas emissions from farms by reducing direct and indirect energy use.

- The intergovernmental Panel on Climate Change (IPCC) has estimated the global technical mitigation potential for agriculture at 5.5 to 6 Gt of CO2 equivalent per year by 2030. Most of this total (89 per cent) can come from carbon sequestration in soils, storing carbon as soil organic matter (humus), something which can be done through agro-ecology

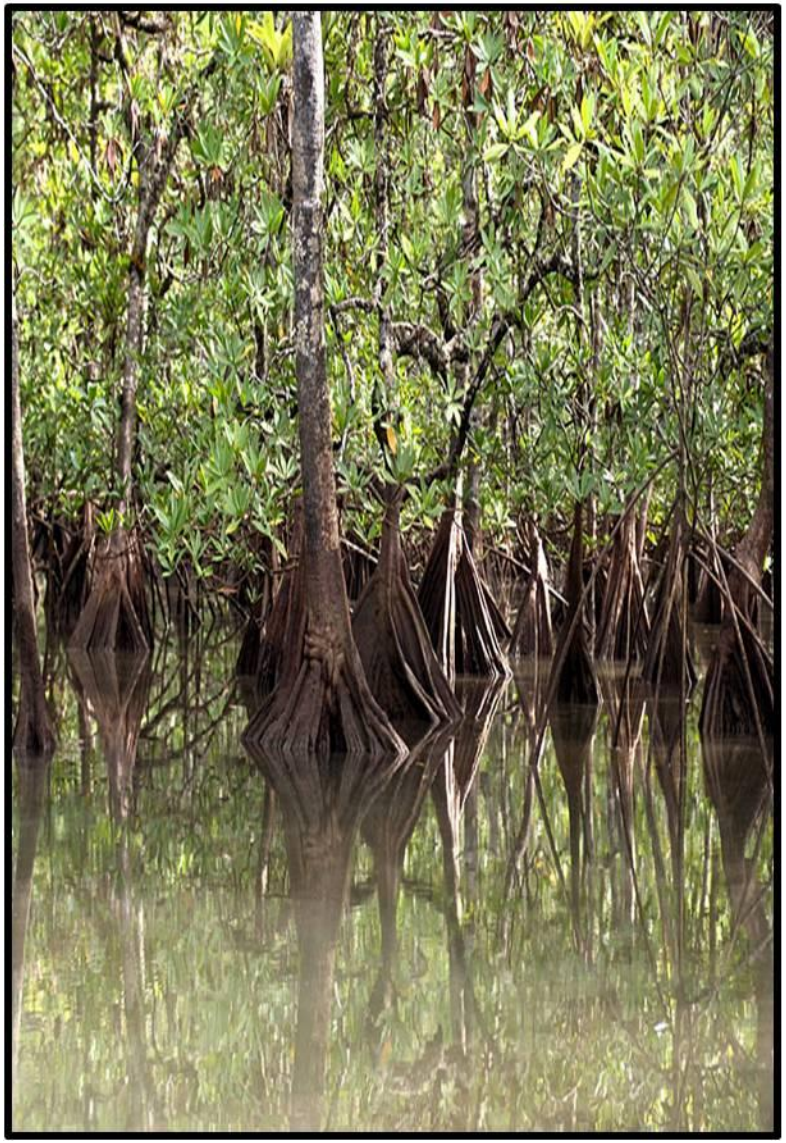
USE OF WASTELAND

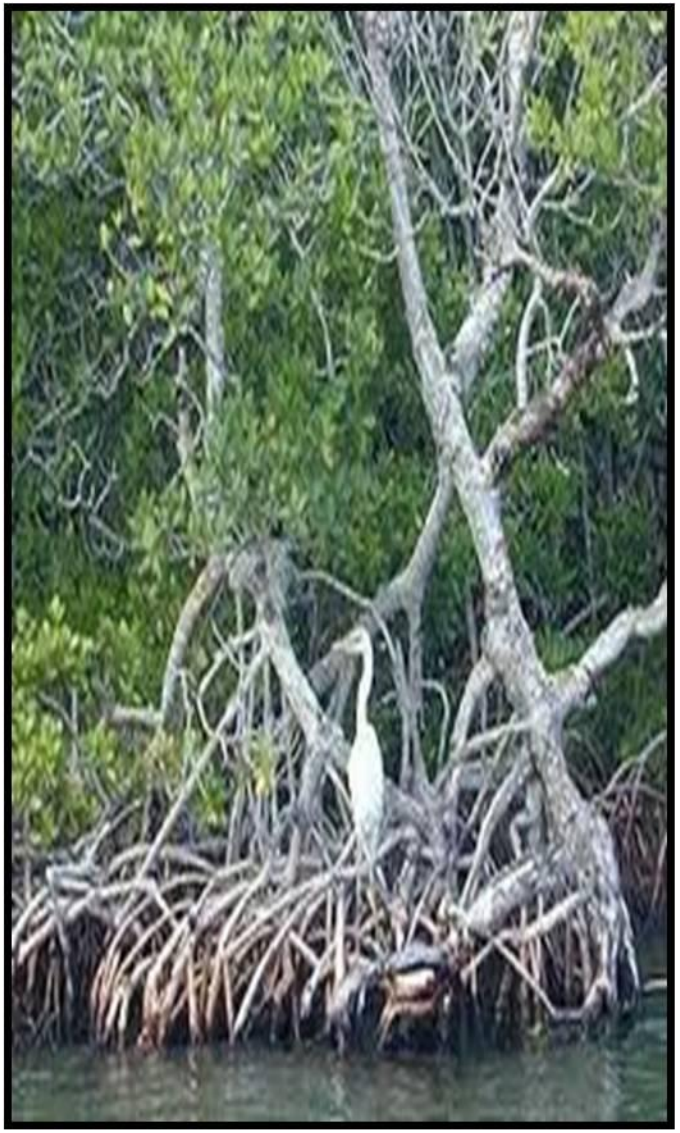
- The country has wasteland of 1.30 million hectares. This is mainly saline; in inland areas and in the margins of deserts. In addition to this, there are huge un-surveyed areas on margin of desert.
- Technology is available for salinity – resistant crops, trees including horticulture.
- This could be fruitfully grown in these areas providing sustainable livelihood. This will enhance cultivable areas.
- A private-public partnership programme.

USE OF WETLAND

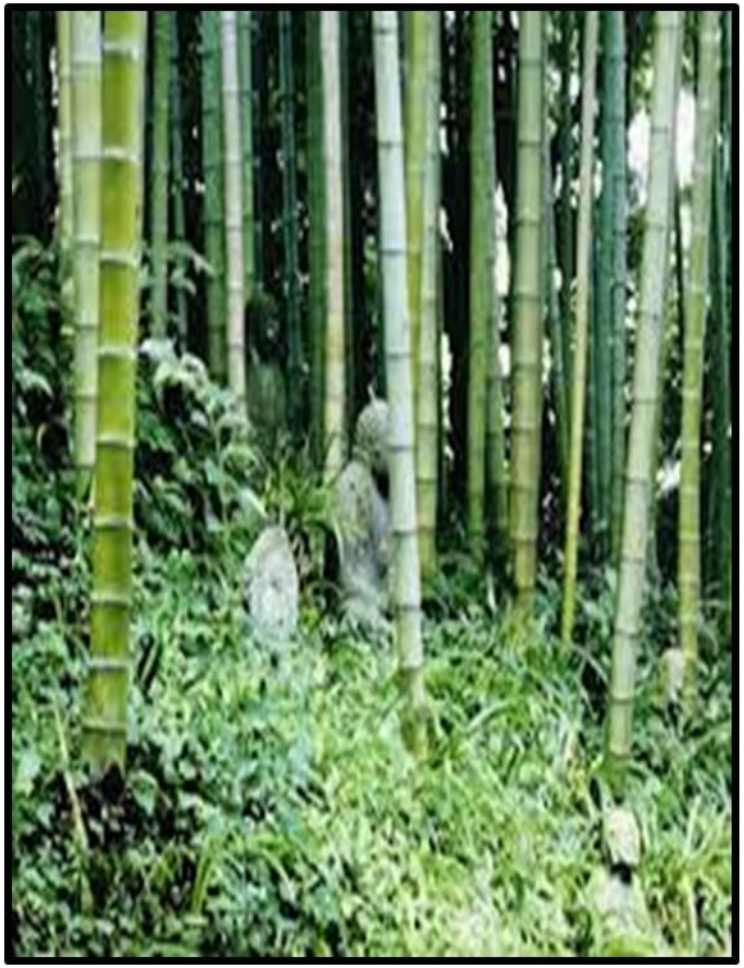
- Wetland is an area of land where soil is saturated with moisture permanently or seasonally covered by sea water.
- Nearly 25 lack hectares of waste land are in our country. A majority of such land is not surveyed and is spread along the huge coast line of the country.
- Wetlands may be converted into major production areas for sea food - fisheries, vegetation, and medicinal plants with changing management practices for production of rice to reduce anaerobic decomposition that is the major source of methane. All these have huge internal and external markets and will be a great support for food security.
- A public private partnership model could be introduced. This is essential to make up reduction in the area under agriculture due to industrialization, mining, expansion of urban areas and infrastructure of highways and railways.

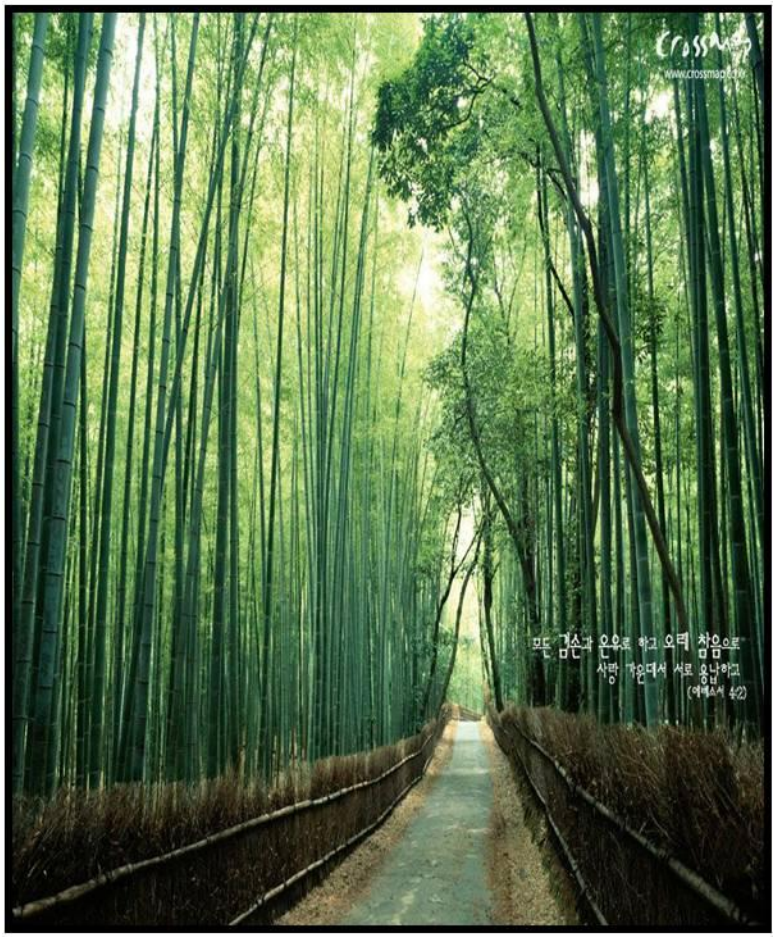
USE OF WETLAND – Mangroves



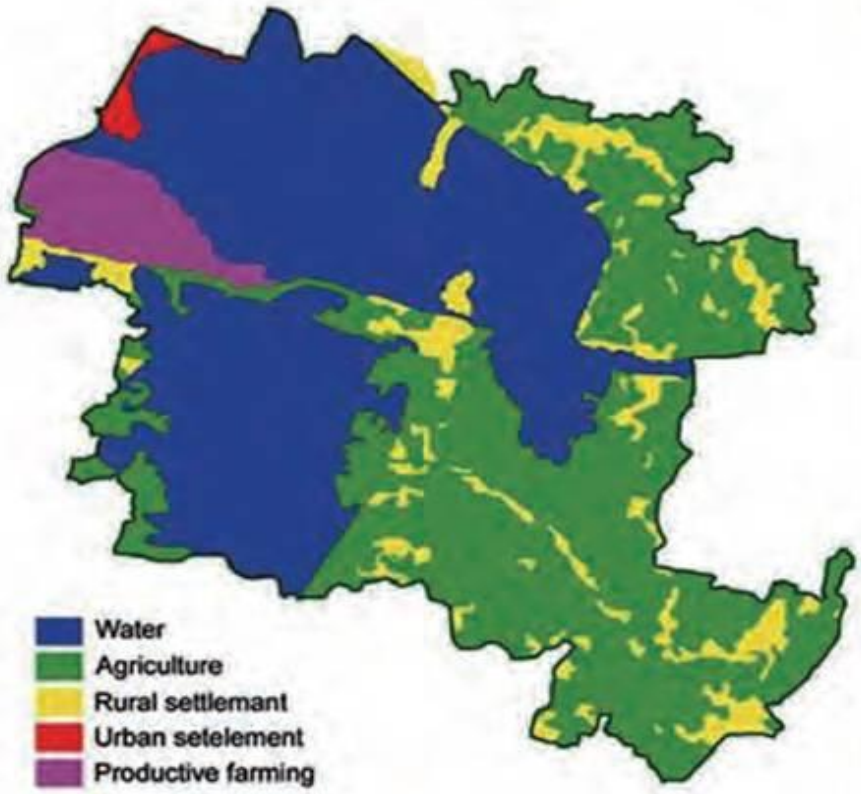


USE OF WETLAND – BAMBOO





DIFFERENT LAND USE CLASSES IN EKW



Land use	Area
Water body	5,852.14 ha of which fish farming roughly constitutes about 3,898.70 ha.(45.93%)
Agriculture Land	Approximately 4,959.86 ha.(38.92%)
Garbage Disposal Site	602.78 ha. (4.73%)
Urban Settlement Area Rural Area	91.53 ha.(0.73%) 1234.99 ha.(9.69%)
Total Area	12500.00 ha*

*Additionally 241.30 ha. Are being added to the system for making the system integral.

DEVELOPMENT OF WETLAND

EKW through its bheries / fisheries caters to the food, sanitation and livelihood security of its nearly a lakh inhabitants by recycling 980 million Lrs of Sewage per day with a detention period of 30 days. About 150 tonnes of vegetables, 10500 tonnes of table fish per day in addition to nearly 11 Mt Tonnes of Rice per year. This intricate link of eco system productivity based on recycling and livelihood has created a favorable market mechanism that rewards conservation initiatives. This is called the Bio rights framework and is a model that can be suitably adapted in systems with comparable profiles of form and function. South Asian Forum for Environment (SAFE) led by Dr. Dipayn Dey has played catalyst role in this entire development which can be replicated

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East Kolkat Wetlands

RESEARCH & DEVELOPMENT

There is urgent need to initiate research in all our agro climatic zones on following;

- Develop crop practices under increased temperature conditions based on soil health and moisture analysis.
- Research to know absorption of CO2 and release of Oxygen by different crops, grasses, plants and trees under different agro climatic conditions; and identify plants, species, grasses, which can absorb maximum CO2 from atmosphere and from that identify plants which are suitable to urban & industrial township.
- For value addition options in agriculture particular with focus on using all parts of the plant.
- Identify crops which improves productivity with enhanced consumption ofCO2.
- Tissue culture and cloning in as many varieties as possible and its rapid multiplication. e.g. banana tissue culture exists but not available for farmers all over country
- Diagnose nutritional deficiency in plants and soils for precise application of fertilizer.
- Identifying crops which flourish in saline soil and saline water and even seawater.

ORGANIC FARMING

- A study by Rodale Institute, USA has established that organic farming can play a very important role.
- In one example of organic farming, a 23-year experiment by the Rodale Institute compared organic and conventional cropping systems in the United States and found that organic farming increased soil carbon by 15-28 percent and nitrogen content by 8-15 percent.
- The researchers concluded that the 65 million hectares of corn and soybean grown in the United States were switched to organic farming, a quarter billion tons of carbon dioxide (or about 4 percent of annual U.S. emissions) could be sequestered.
- **According to the report on "The future of Food and Farming by The Government Office for Science – London – 2011 UK** Increasing organic carbon pools in world's soil by 10% would be equivalent of reducing atmospheric CO_2 by 100 ppm.*****

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Some plants which have a special role to play

Vetiveria zizanioides (Vetivar System in Agriculture)

- Carbon Sequester/plant – 2.5 Kg/ year
- Reduce erosion & improve soil texture
- Can covert sandy soil to productive land by using mulch
- Crop yield increase through better soil

Another similar plant is "Prosopis Juliflora" – Ganda Baval.
It is a salinity resistant plant and very important bio-fuel and can grow on any degraded or saline soil including desert area. Similarly Bamboos and mangroves are very important species

increase ground water recharge by 70%

- Very good fodder
- Good for mushroom cultivation
- Wastewater treatment
- Stabilization of fish ponds
- Good quality compost
- Construction related inputs

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SPECIAL PLANTS – BAMBOO

Bamboo - the king of grasses and popularly known as 'friend of the people' is the fastest growing plant on earth. There are over 1250 species of bamboo and can be found on every continent other than the poles. It also grows right from the sea level to an altitude of about 13,500 feet and is used widely as a "green" material in a wide variety of products. Importantly bamboo

- Is also capable of significant CO2 sequestration because of its typically large and rapid biomass growth at 10-30 percent annually (compared to 2-5 percent for most trees)
- Can be selectively harvested in a relatively short span of 3-5 years unlike several other softwood at 10-20 years
- Helps environmentally safe and reliable disposal for excess nutrients in waste waters including the streams from livestock farming and sewage plants
- Provides its net-like root system that protects watersheds, reduces rain runoff, prevents soil erosion
- Can be grown in soil damaged by overgrazing or poor agricultural techniques
- Can withstand droughts, grows in rainfed / semi-arid regions, acts as a windbreak or shelter-belt for crops when mature and tall; allows under-cropping of cash crops such as ginger, tuberous crops and some legumes.

CONSERVATION TILLAGE

- Conservation tillage is an integrated tillage system in which large amounts of crop straws are used to cover the soil and minimize all the possible tillage activities.
- Conservation tillage, which employs the technologies such as no tillage or minimum tillage, micro-terrain rebuilding, land covering, and controlling weeds with herbicides, is aimed to reduce the disturbance and increase the straw coverage to soil (Gao HW, 2005; Gao WS, 2007; Li HW, 2008).

- It is composed of four essential components (Di Y, 2008):
  - Planting techniques without tillage;
  - Covering soil with straws or plant residues;
  - Deeply loosing the soil; and
  - Integrated control techniques on weeds and pests.

Conservation Tillage – increase in Soil Organic Carbon (SOC)

- reduce the disturbance on soils to protect soil organic matter from oxidization and mineralization
- Straw coverage adds more soil organic carbon, which means conservation tillage may increase soil organic carbon in different degrees
- affects soil temperature and moisture status, which in turn affects soil carbon stock indirectly. Soil temperature affects micro organisms' activity, and determines the decomposing speed of soil organic matter
- Different tillage practices may have different effects on micro organisms' activity, which may lead to varying accumulation of organic matter in soils.

BIO CHAR

- Bio char is the solid remain of heating biomass in an oxygen-depleted environment. Unlike the carbon found in most organic matter, biochar carbon is chemically altered during the heating process and forms in to “benzene-type” ring structures that are very resistant to attack by microorganisms. As a consequence, biochar carbon can remain stabilized for long periods of time - hundred to thousand of years - and could be an important way of storing carbon that has been scavenged from the atmosphere during photosynthesis. What is more, biochar can enhance soil health and has been demonstrated to promote plant growth in some situations.

- Bio char, its proponents suggest, offers potent ways to meet pressing challenges across agriculture, climate change and energy - and moreover, to address all three domains simultaneously in an unprecedented ‘triple win’. This is the ‘magic’ around which biochar’s political economy of promise has emerged.

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Source of Biomass for Bio char

- Charcoal and ash from crop residue burnt in the fields (traditional practice)
- Charcoal produced from Prosopis Juliflora
- Rice husk charcoal - a by-product from cook stoves / parboiled rice mills
- Charcoal from cook stoves
- Other biomass

Bio char has got multiple applications and Bio char mulching has got multiple advantages

- Retention of the soil moisture, reduction of evaporation of water from the soil
- Reduction in leaching of the bio / chem fertilizers applied
- Increase in the soil microbes / worms at the bio char and soil interface
- Regulation of the soil temperature
- Suppression of weeds by blocking the sunlight the weeds sprouting and growth is suppressed.
- Repulsion of the termites / ants which might attack the live plants
- Over a period of time due to various activities the bio char mixes with the soil.
- Prevents soil erosion too.
- Can increase the ph of the soil towards neutral (mulch very good for acidic soils)

It helps in soil conservation and improvement. The sandy soil can be easily converted to rehabilitation using vetiver mulch.

One plant – Multiple benefits
.Water conservation with mulch

- Erosion control
- Soil moisture retention
- Good quality fodder –rich in protein
- Leaves & Cums optimum for mushroom
- Helps treat wastewater

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THE LIVESTOCK – BACK TO ORIGINAL BREEDS

In livestock sector, country has made considerable progress. India is a major dairy & meat producing country in the world. It adopted and introduced cross-breeding and frozen semen technology in late seventies. Global warming increase in temperature affects milk yields of cross breed animals which are quite sensitive to heat. Hence emphasis has to be back of our original breeds like Gir and Kankaraj cows of Gujarat. They are tolerant to heat, can walk long distance for grazing, and, survive even only on grass. In fact Brazil has adopted this breeds and it has largest breed of Gir cows in the world. Similarly Kathiawadi horse and Patanwadi sheep can walk long distance for grazing and survive in extreme heat condition. The focus will have to be on pure breeds and farmers may have to be given incentive to adopt them.

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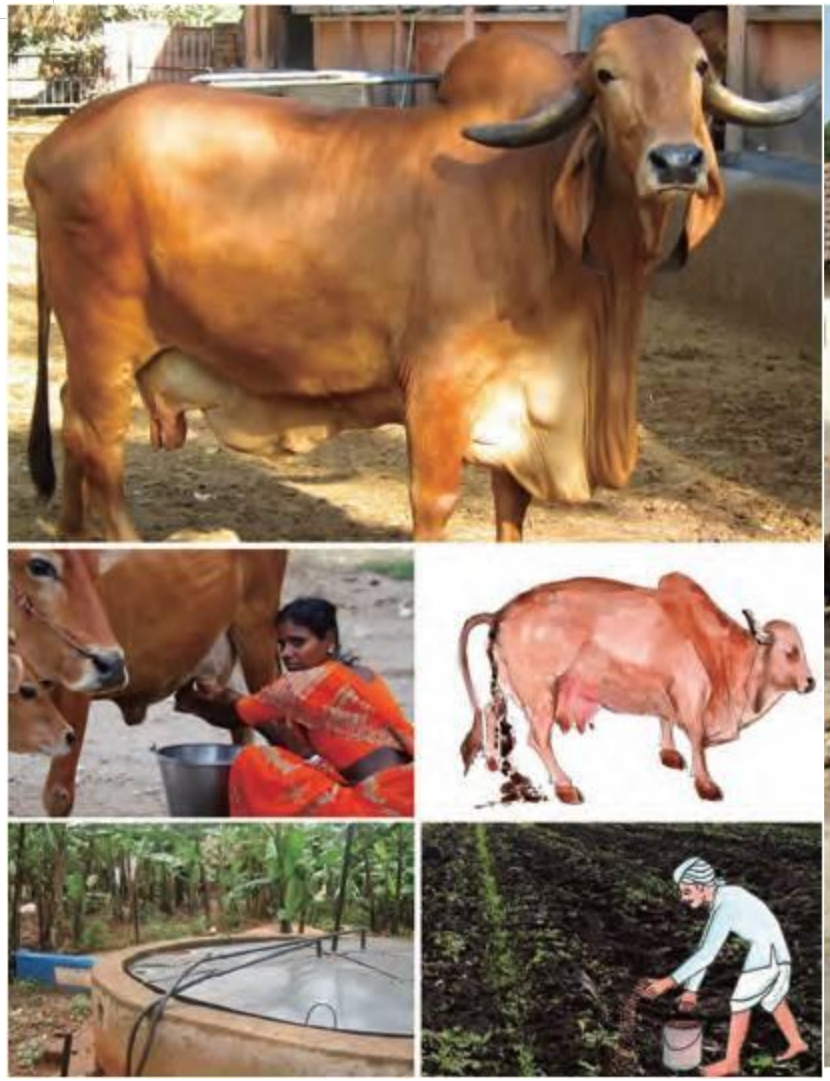
THE LIVE STOCK – BACK TO ORIGINAL BREEDS



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CARBON CREDIT

- There is now international Incentive policy for industries, manufacturing companies and other such organizations if they reduce emission of harmful gases as per established norms: "Carbon Credit".

- A policy framework is required for an incentive scheme for farmers, NGOs and even for by State Governments, if they take up reduction in CO2 through agriculture/Vegetation including fisheries by development of wastelands and wetlands.

- While agriculture is highlighted for its GHG emissions, but such estimates do not take in to account CO_2 absorption by it from atmosphere.

- In India there is nothing like a waste as far as agriculture is concerned because Cowdung is used for biogas / fertilizer and agriculture waste in converted to compost by every farmer as it enriches the soil nutrient contents.

URBAN AGRICULTURE

There is need to promote Urban Agriculture

- This exists almost with majority of urban households who have some open land.
- Even in the multistory building, there is some kind of tree growing, grasses or ornamental plants.
- Even people staying in the flats like to keep plants in pots in lobby area.
- But there is a gap about knowledge of agricultural practices, what plants they should grow and how to treat them. There are no urban agriculture extension centers or even Agro Service centers where such guidance could be available along with basic inputs of seeds, fertilizers, farm equipments

URBAN AGRICULTURE Cont….

- People end up buying high cost ornamental plants with high mortality and go on replacing it every year.

- Kitchen garden could be promoted to meet the requirements of vegetables and wherever more open areas are available, promote horticulture and floriculture. However, at present to government department could be said to be responsible for promotion of urban agriculture.

- There is a need to take urgent initiative on urban front. This will go long way in reduction in CO2 level in urban centers and to contain extent help in food security.

Sow and Reap, Grow and Eat

Creating green spaces

Mumbai Port Trust Terrace garden at Victoria Dock

Presented by : Uday Acharya
Trustee, Vidya Vaaridhi Trust (Urban Leaves)

City: Mumbai
16th July 2011

Urban Agriculture – Soil + Compost (75 + 25 %), excellent results.
Mumbai Port Trust






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SOIL HEALTH CARD

This is the key to greener agriculture. This has to be provided to all small & marginal farmers free of cost at their door step. The card can have details of soil health characteristics and moisture content along with details of crops that can be grown depending on soil types, nutrients needed and market price of prevalent crops over the past few years. This is an inter-disciplinary task - State Agricultural Universities (SAUs) can prepare the software for crop option, nutrient requirement and market price at Central Computer Centre. The local level Extension Administration can then send by internet. The soil and moisture data of each land holding and ownership details and receive back complete data analyses through Information and communications technology (ICT). This approach already exists in Gujarat where it has successfully brought about sustainable agriculture and improved productivity of crops which already have the capacity to withstand adverse climatic conditions. This has also reduced expenses on fertilizers due to dropping of un-required fertilizer and has enhanced agriculture growth & income of farmers. This approach also envisages directing fertilizer companies to sell fertilizer on per-kg basis moving away from the present bulk packages and stringent measure against companies/persons who sell spurious seeds.

KRISHI VIGYAN PRASAR

Krishi Vigyan Prasar is a specific need of our centre for communication of Science and technology to farmers. This can be a new centre or existing institute like Central Research Institute for Dryland Agriculture (CRIDA) could be up-graded for this purpose. This will have Knowledge Bank of :

- Existing research and development experiences existing in the different parts of the country, ICAR, SAUs, State Governments. cooperatives NGOs and both private & public organizations.
- Empirical experiences to progressive farmers.
- International experiences that exist in many parts of the world including countries like Israel, China & Japan.
- It can compile and disseminate all information related to climate change - its adverse impact, remedial measures - to all tehsils through a Centralized Computer net-working system.
- It will also have linkage with Indian Space Research Organization (ISRO), District level Meteorological stations of Ministry of Earth Care and could track details of local level changes in climate and pass it on for analyses and feedback to research stations of different crops of ICAR and SAUS. This centre can be a link with SAUs and KVKs ATMA and Local level State Extension Services. This can in turn be linked directly with village based computer networks wherever feasible.

VILLAGE LEVEL EXTENSION

Strengthen extension services to sensitise farmers about impact of climate change at the village level by team of Agri. Scientist and local agric and veterinary extension team. This could also involve the local non-Government organizations, APMC (Agricultural Produce Market Committees), Cooperatives, Self Help Groups, dealers of inputs and the traditional Village Level Workers. This can complement action considering the fact that :

- Farmers below poverty line need to be provided certified seeds without any cost at least once in five years.
- At present they use their-own produce year after year and hence productivity is low
- Focus on providing assets through credit to poor farmers individually, through programmes of Small & Marginal farmers development Programme.
- Traditional Extension Services Involve VLW who most often are now involved in multifarious activities. Often they are not agriculture diploma holder. They only provide knowledge about production. But the need is (a) choosing right crop which can sustain itself based on Soil Moisture and Health Analysis and Market price (b) to provide information needed on market requirement including packaging (c) understanding about impact of climate change and use of eco-agriculture and bio-diversity. Specific attention needs to be paid for women who are now increasingly responsible for farming as men go out for earning under NREGA.

NEW SCHEME – V

AGRO INDUSTRIES IN VILLAGES

- **We have rapid industrialization - in fact very good growth in agro industries, only in urban centers .**
- **But Agro industries based in villages important for adding wealth to rural areas and remove urban-rural disparity of income.**
- **It can also reduce migration, especially of young unskilled labor through new employment opportunities at the local level.**
- **Can alleviate social pressures and demands on public services within the city.**
- **To achieve this rural and remote areas will have to be connected with good road and 24 hours three phase electrical supply.**
- **This has already happened in Gujarat and in Maharashtra, Andhra Pradesh, Karnataka and can be replicated with little push from the top across India and accelerated by**
  - **Promoting Innovation**
  - **Use knowledge economy tools**
  - **Train rural youth for entrepreneurship and in multi skills**
  - **Build capacities of present traders.**
  - **Provide support infrastructure & energy.**
  - **Link opportunity with local human resources**

CONCLUSION

POTENTIAL FOR DEVELOPMENT

- **Number of countries in the world are experiencing decline in growth of agriculture especially food crops. It is increasing migration to urban areas leaving agriculture behind. Heavy corporatisation of farming in some developed economies is another such reason.**

- **Greater prosperity in developing countries will see an expanding middle class with growing appetite for meat and dairy products apart from vegetables and food grains.**

- **There is national and international demand for bio-fuel, which has diverted growing of food crops.**

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CONCLUSION

Enhance productivity

India's share of arable land in the world is 11.5% (only second to USA)

- In cotton we have reached world highest yield.
- Need to improve in several others. It is clear when we compare as follows:

China	India
Maize 4900 kg / ha	2100
Paddy 6000	3000
Soya bean 1740	1050
Tomato 2400	1430

- We have more than 1.30 million hectare wasteland / equal or more area as un used – wetlands where salinity resistant crops can be grown with fisheries using tools of knowledge economy and replication of our own proven experiences

- We need to bridge gap between average and optimum production first.

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CONCLUSION

LEADERSHIP FOR SUSTAINABLE DEVELOPMENT

- Global warming is a threat – can be converted into an opportunity
- Win-win situation for all if efforts are channelized with focus on sustainable development with agriculture at its centre.
- There is over all awareness at all levels from school children to senior citizen with public and private players.
- The key to all these is LEADERSHIP: motivated & committed to promote sustainable development with a clear vision, detailed plan and implementation strategy based on use of knowledge economy.
- Leadership at all levels - village, taluka, district, state and centre needs to focus on farmers needs to be involved and made statutory responsible for development of small farmers who are left out of development process.

CONCLUSION

LEADERSHIP FOR SUSTAINABLE DEVELOPMENT

- The Elected: Sarpanches, Taluka Pramukhs, District Pramukhs, MLAs, MPs, Cooperatives, trade and industry association and like.
- The Non Elected leaders: Owner/Entrepreneurs, Managing Director of companies, NGOs, Civil Servants, Educational Leaders (teachers and students), Spiritual leaders, International Organizations.

Such transformation will help meet challenges of poverty and global warming which seems to be un-surmountable.

It requires determined and persistent effort to reach out goals to overcome all these.

If all act together with a goal in view - there will be all round prosperity.

These are very important public policy considerations for India to strengthen her economic. Food, nutrition and livelihood security by using agriculture as a tool for integrated growth.

India can also provide leadership at the regional and global levels through this perspective.

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Atharvaveda Hymn LXVII

१. पश्येमं शरदः शतम् ॥

1. May we see for hundred years. (4960)

२. जीवेमं शरदः शतम् ॥

2. May we live for hundred years. (4961)

३. बुध्येमं शरदः शतम् ॥

3. May we acquire knowledge for hundred years. (4962)

४. रोहेमं शरदः शतम् ॥

4. May we go on prospering and progressing for hundred years. (4963)

५. पूषेमं शरदः शतम् ॥

5. May we go on being nourished for hundred years. (4964)

६. भवेमं शरदः शतम् ॥

6. May we remain strong and sturdy for hundred years. (4965)

७. भूयेमं शरदः शतम् ॥

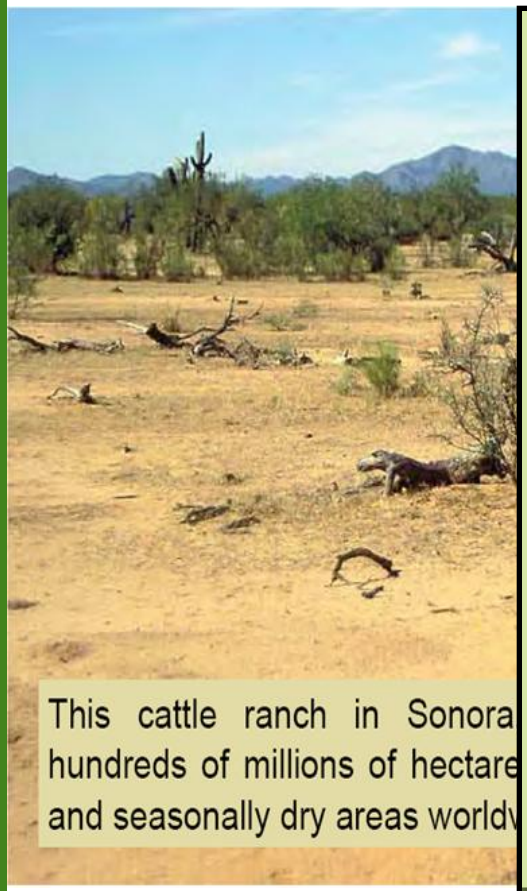
7. May we retain our prestige and influence for hundred years. (4966)

८. भूयदीः शरदः शतात् ॥

8. May we retain all these powers of sight etc., for greater numbers of years than hundred. (4967)

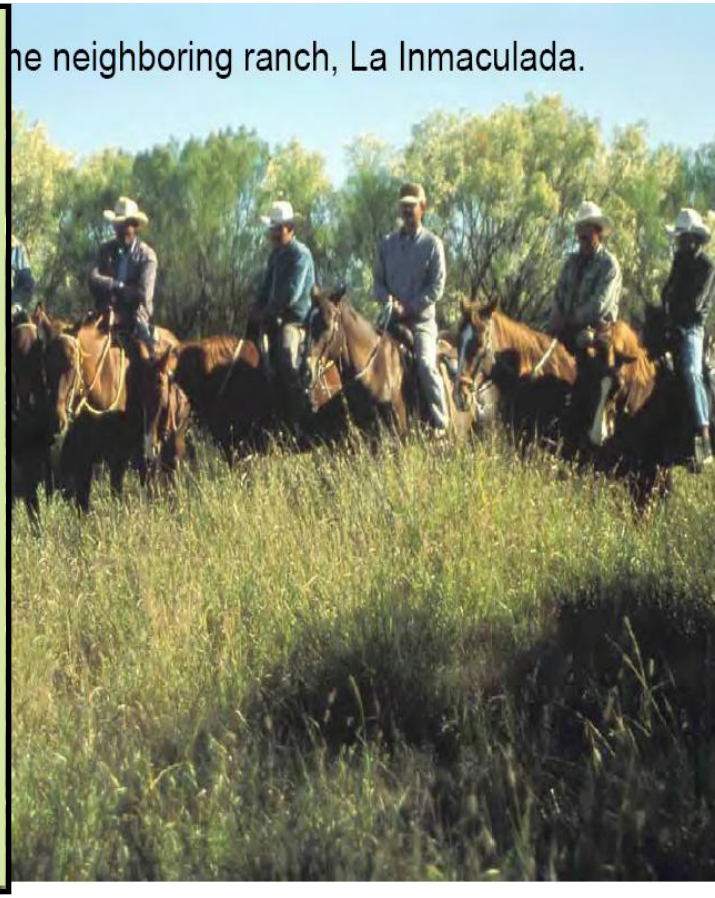
** Compiled by Dr. R.S. Rajan, Distinguished Professor, ISRO*

The International Experience



This cattle ranch in Sonora
hundreds of millions of hectare
and seasonally dry areas worldv

- Same area
- Same rainfall
- Same soils
- Same plant species
- Same season (pictures taken on the same day)
- La Inmaculada actually has more cattle than the drier ranch
- The only difference is management



he neighboring ranch, La Inmaculada.

CONSUMPTION OF CO2 PER HECTARE

- Says Tony Lovell, one hectare is 10,000 sq. meters. If a hectare of soil 33.5 cm deep, with a bulk density of 1.4 tonnes per cubic metre is considered, there is a soil mass per hectare of about 4,700 tonnes.

- If appropriate management practices were adopted and these practices achieved and sustained a 1% increase in soil organic matter (SOM)6, then 47 tonnes of SOM per hectare will be added to organic matter stocks held below the soil surface.

- This 47 tonnes of SOM will contain approximately 27 tonnes of Soil Carbon (I.e. 47 tonnes at 58% Carbon) per hectare.

- In the absence of other inputs this Carbon may only be derived from the atmosphere via the natural function known as the photo-synthetic process. To place approximately 27 tonnes of Soil Carbon per hectare into the soil, approximately 100 tonnes of carbon dioxide must be consumed out of the atmosphere by photosynthesis.

- A 1% change in soil organic matter across 5 billion hectares(estimated waste land in the world) will sequester 500 billion tonnes of Physical CO_2.

(**Tony Lovell – Soil Carbon P/L Australia**)

THE AMERICAN PERSPECTIVE

- Agriculture can
  - Remove CO2 from the atmosphere (via photosynthesis)
  - Store carbon in soils &
  - Reduce emissions in other sectors by displacing fossil fuels with bio-fuels.
- Through agricultural best management practices, we can reduce emissions of
  - nitrous oxide from agricultural soils,
  - methane from livestock production and manure &
  - CO2 from on-farm energy use.

Ref: Keith Paustian et al 2006: Pew Centre: Multiple benefits through mitigation / offsets

IN THE UNITED STATES OF AMERICA

- About 70 to 220 MMT of carbon could be stored in U.S. agricultural soils annually If farmers widely adopt the best management techniques.
- With nitrous oxide and methane reductions, these mitigation options represent 5 to 14 percent of total U.S. GHG emissions.
- To achieve maximum results, however, policies must
  - Attract farmers to
    - Adopt practices that increase soil carbon
    - Efficiently use fertilizers, pesticides, irrigation, and animal feeds.
  - Ensure funding to improve the measurement and assessment methods for agricultural GHG emissions and reductions, including expansion of the National Resource Inventory.

EU PARLIAMENT 2009

- Affirms that EU agriculture can contribute to the Union's mitigation
- Objectives
  - promote carbon storage in soil
  - develop production of sustainable renewable energies & ;
  - reconcile economic, social and environmental imperatives with the natural potential of each ecosystem
  - provide information, training and incentives – practices that limit GHG emissions and/or fix carbon, including
    - simplified cultivation techniques that provide plant cover (such as reduced or no-tillage / leaving crop residues on the ground)
    - facilitate intercropping and crop rotation,
    - maximize photosynthesis &
    - help enrich soil with organic matter

EU CAP

- Will offer financial incentives for EU farmers to implement agronomic adaptation measures in each region
  - Optimize water resource management (more efficient irrigation systems, hillside reservoirs, etc.)
  - Choose crop varieties
  - practice crop rotation according to drought and disease considerations;
  - protect the soil from water and wind erosion by ensuring organic matter content;
  - plant hedges or wooded areas on the edges of farmland to retain water, limit runoff, act as windbreaks and provide shelter for crop auxiliaries such as pollinating insects
  - monitor and control insects and disease

Let's Learn & Share Together for a global mission

Mainstreaming Agriculture for Climate Change Mitigation

Thank You for your patient hearing

National Council for Climate Change,
Sustainable Development and Public Leadership

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