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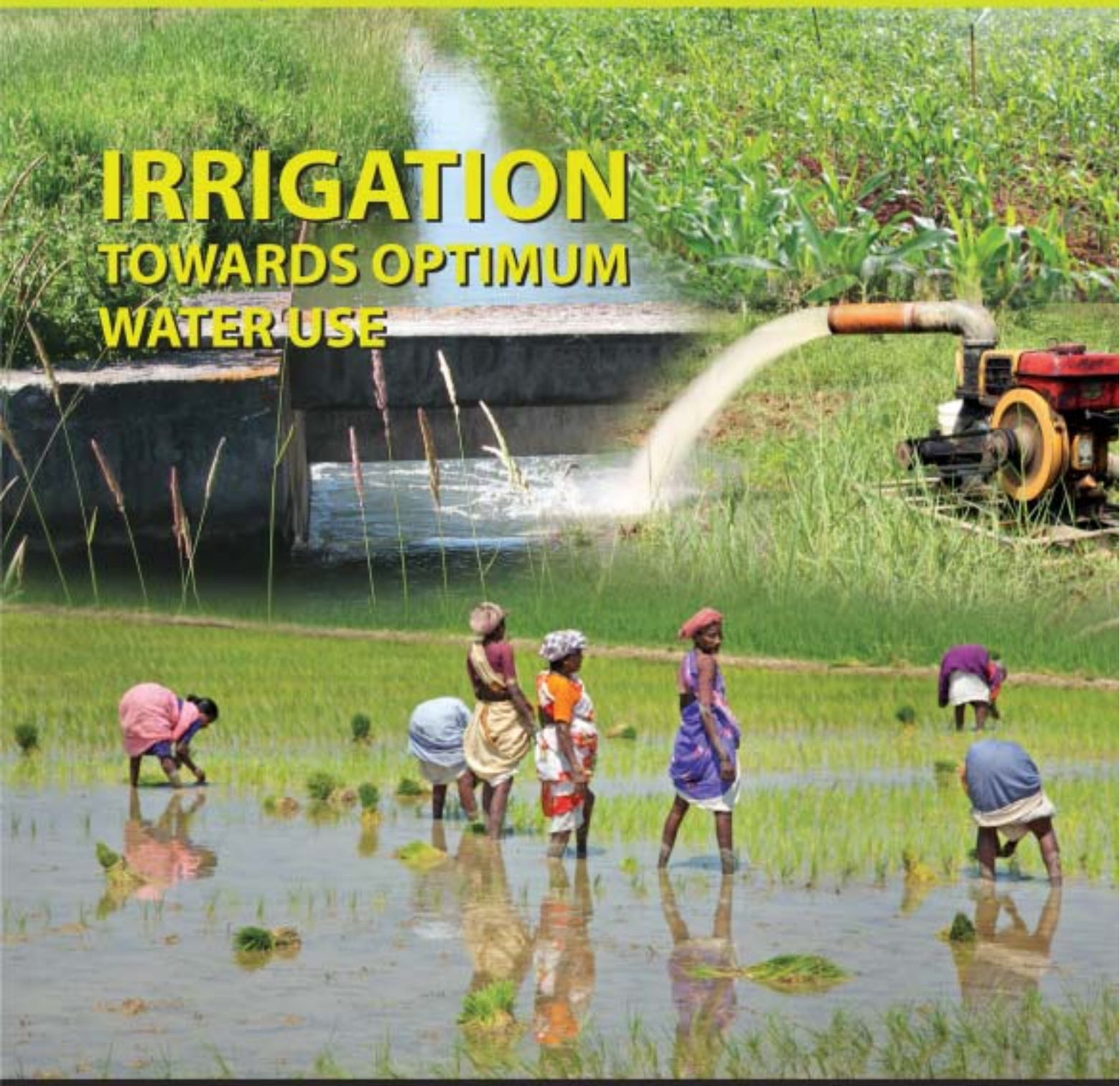

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TOWARDS OPTIMUM WATER USE

RURAL RETAILING IN INDIA

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EDITORIAL

Welcome to the August edition of the magazine. In the cover story we have focused on the Irrigation sector. The story scans the progress made so far and looks at the main issues in water management and its impact on agriculture. Clearly growth of agriculture hinges on availability of water and reach of irrigation. Organic farming, Agri Business, Agricultural Credit, Dairy Sector, Impact of Climate Change and Sericulture are other articles that will definitely hog the readers' attention.

India is readying for a second Green Revolution in the coming years. This was the message from Prime Minister Dr. Manmohan Singh's Independence Day address. He emphasised the need for another Green Revolution to meet the requirements of a burgeoning population and changing food life styles. Expressing the resolve of the Central Government to raise farm production, the PM said, We need technology which would address the need of dry land agriculture...Our agriculture should also be able to deal with new challenges like climate change, falling level of groundwater and deteriorating quality of soil.

To give a deep technology push to the farming sector, the Prime Minister announced the setting up of an institute in the name of renowned agricultural scientist Norman Borlaug. The mandate of the proposed Institute will be to facilitate availability of new and improved seeds and technology to the farmers of India and South Asia in general. According to information, the institute will come up at Pusa in Bihar in collaboration with the International Maize and Wheat Improvement Centre (CIMMYT) and work in tandem with Borlaug Institute of International Agriculture based in Texas and other research centres. The institute will be a force multiplier at the R&D front in agriculture.

In storage, there is news about new technology infusion. India is all set to welcome foreign technology to augment the storage capacity of grains. India is in talks with Argentina to develop a new technology for warehousing. Recently a team visited China to study storage technologies there. The recent controversy on rotting of wheat for want of proper storage facilities raises the urgency of the issue. India faces a shortfall of 15 million tonnes in storage capacity. We wish all success to the new intiatives.

A.K. Garg
Editor-in-Chief

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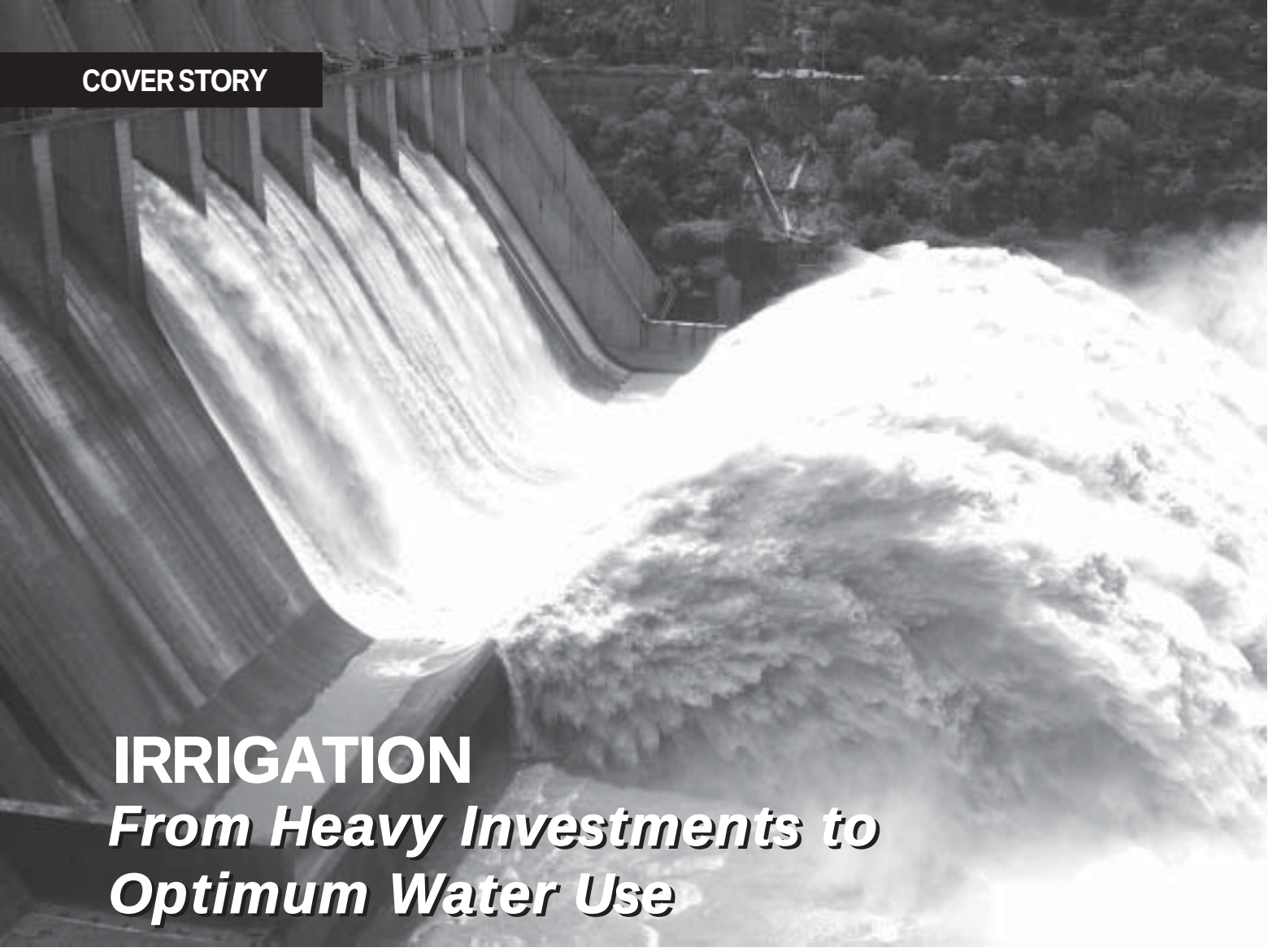


IRRIGATION
From Heavy Investments to Optimum Water Use

By **G. Kalyan Kumar ***

Since Independence, India has built up a formidable irrigation infrastructure. The gross irrigated area is 78 million hectares and the ultimate irrigation potential is around 139.9 million hectare (Mha). With one third of irrigated cropland in its kitty, the country is divided into six basins based on the availability of water resources. More than 50 percent of all public expenditure on agriculture goes into irrigation which falls into three categories – Major, Medium and Minor.

Surface systems, such as large dams, long canals attract maximum investment. Deep-well projects involve large capital outlays. The perennial rivers of India have facilitated development of river irrigation in many states, particularly in UP, AP, Punjab, Haryana, MP and Rajasthan. Well irrigation dominates in UP, Punjab, Rajasthan, Gujarat, Maharashtra and Madhya Pradesh.

Achievements

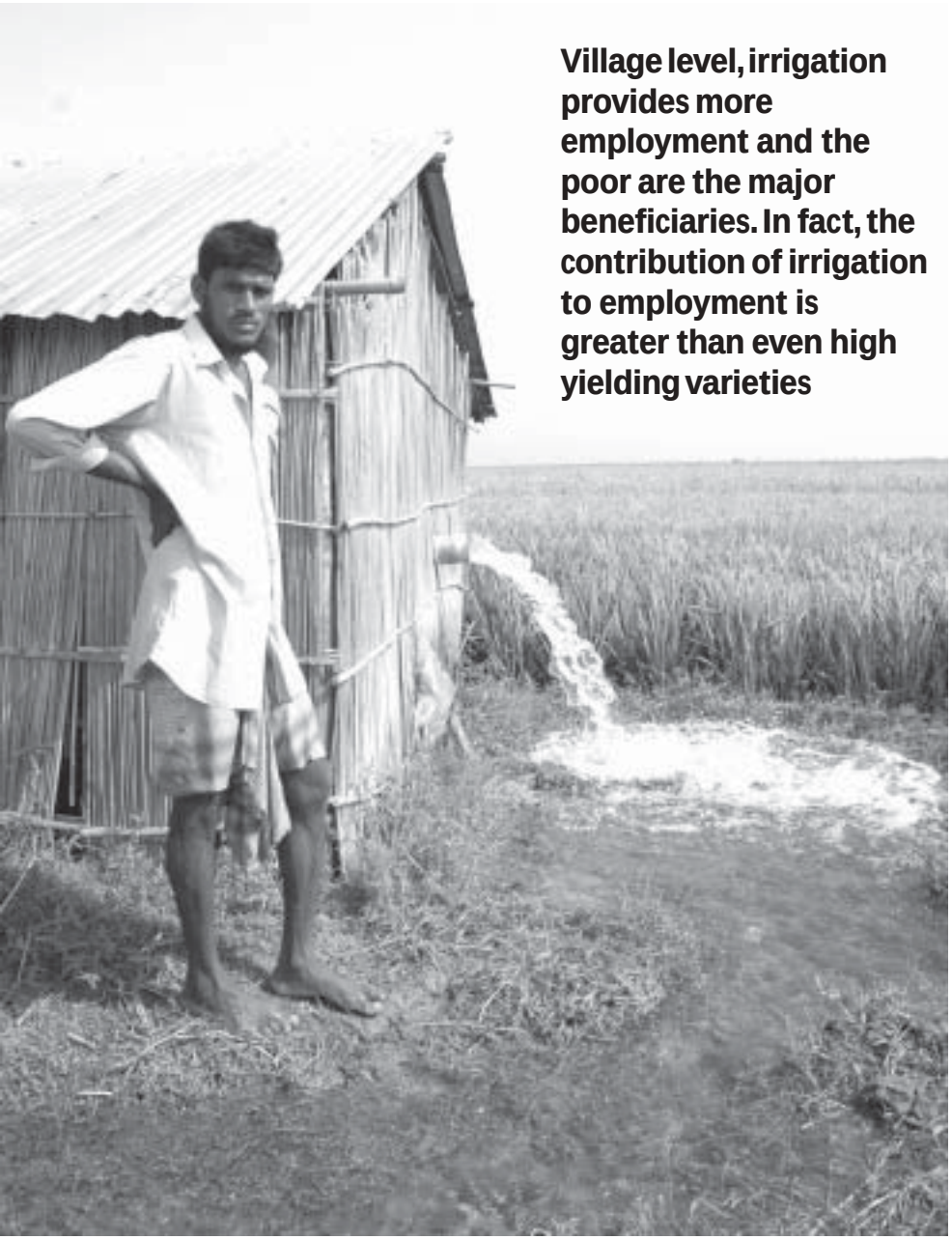
India's emphasis on development of the irrigation sector right from independence was to protect the farmers from the vagaries of monsoon. Some of the large- and medium-sized irrigation works in India like the Indira Gandhi Canal expanded agricultural coverage to arid regions. Though India has the second largest irrigated area in the world, the area under assured irrigation or at least minimal drainage is not adequate. So, Indian irrigation is searching for ways and means to expand water use efficiency as the current water use efficiency of canal irrigation is only 35 percent, which is the lowest in the world. It is estimated that 10 percent increase in water use efficiency can bring an additional 14 million hectares under irrigated cultivation. India's irrigation strategy has to dovetail with sustainable use of water resources.

Private Irrigation

Small and privately owned irrigation systems (dugwells, tubewells, etc.) provide more than 50 percent of irrigation in India. More than 70 percent of Indian farmers are small scale operators cultivating plots less than one hectare. Shallow-well schemes and small surface-water projects, mainly ponds or tanks are being supported by government credit but otherwise installed and operated by private entrepreneurs. Roughly 42 percent of the net irrigated area is from surface water sources. Tanks, step wells, and tube wells provide another 51 percent; with the rest coming from other sources.

AIBP

To expand the irrigation cover in the country and raise agricultural production, the Government of India launched the Accelerated Irrigation Benefits



Village level, irrigation provides more employment and the poor are the major beneficiaries. In fact, the contribution of irrigation to employment is greater than even high yielding varieties

Programme (AIBP) in 1996. Until March 2007, the scheme created irrigation potential of 45.53 lakh hactares. Only major & medium irrigation projects of the PM package are assisted under AIBP.

The *Bharat Nirman* programme also has an irrigation component to create irrigation potential of 10 million hectares. They include major and medium irrigation projects. Its operational domain includes Extension, Renovation and Modernisation of major and medium projects. But it has no separate provision of funds and no state wise allocations are also made.

Poverty Eradication

Studies have established the varied benefits of irrigation to the target population. The increased food security to the country; increased agriculture incomes in irrigated areas; the success of the green revolution, are all linked to timely availability of water for crops independent of rainfall. In addition to the direct benefits there are indirect benefits emanating from forward and backward integration.

For every Rs 100 of direct benefits the Bhakra dam generated 90 rupees of indirect benefits for the regional economy and made an impact in areas even beyond the region (World Bank, 2005). Similarly, the impact of the green revolution in the North Arcot region of Tamil Nadu proved that each rupee spent on irrigation led to an additional value generation in the non-farm economy (IFPRI, 1985).

About 50 percent of the growth in the non-farm economy was due to agricultural demand for inputs and marketing services and the remaining 50 percent was because farmers as consumers had higher purchasing power to buy more consumer and other goods (Chambers, 1988). In fact, the provision of irrigation improved the returns on social sector investment as well.

Returns to five years of education were 32 percent in irrigated districts and zero in un-irrigated districts (Pritchett, 2002). Chambers (1988) mentions that impact of irrigation on the livelihoods of the rural poor about employment incomes, security against impoverishment, non-compulsive migration, and improvement in the quality of life. In terms of food security in India, the 35 percent irrigated area provides more than 60 percent of the food production.

Studies show that at the village level, irrigation provides more employment and the poor are the major beneficiaries. In fact, the contribution of irrigation to employment is greater than even high yielding varieties. Studies show that there is an increase in number of days work required per ha with irrigation compared with rainfed condition ranging from 60 percent (Datiwada canal) to more than 150 percent (Ferozpur, Punjab) (World Bank, 2005).

The increase in value and incomes which irrigation provides can be judged by two more indicators: (a) The ultimate impact of irrigation on reduction of poverty depends on other factors such as the structures of agriculture production, rural institution, the consumption feed back and labour mobility. In states like Bihar, UP, and Tamil Nadu high irrigation coexists with relatively high rates of poverty (Bhattarai, 2004).

Social Gains

Despite criticism that large dams benefit only large farmers, studies show that 40

percent of the beneficiaries of major irrigation systems are small and marginal farmers. Large farmers form only 12 percent of the command area of the major irrigation schemes (Joshi, 1997). In addition, the increased income of labourers who are not direct beneficiaries of the irrigation system is also substantial.

Besides, the increased number of working days, the wage rate also increases when there is provision of irrigation. These are great benefits for the landless that migrate every year to urban areas to get employment during the non-monsoon period leading to fragmentation of families. Studies show that villages with intensive year-round irrigation attract landless population from the surrounding villages who then settle down permanently (Chambers, 1988). Distressed and seasonal migration has a negative effect on education as parents do not lead a stable life. Studies show that after irrigation when people stay in one village, they start sending their children to school. Groundwater-based irrigation largely has the same benefits as surface irrigation. However, groundwater brings greater benefits for small and marginal farmers.

Irrigation Potential

In 1972, the Irrigation Commission recommended the systematic development of commands in irrigation projects. This aimed to address the issue of under-utilisation of potential. This included setting up of a broad based Area Development Authority up for every major irrigation project to undertake the work of comprehensive area development. Based on this recommendation, the Government initiated a Centrally-Sponsored Command Area Development Programme (CADP).

Continuing population growth and the predicted impacts of climate change, including shifts in precipitation and glacier melt, make the water challenge graver

CADP was an integrated programme that orchestrated all the activities crucial for increasing agricultural production in the command areas to ensure better utilisation of the created irrigation potential. It was a dynamic process of harmonising land, water and crop by a multi-disciplinary team looked after by

Irrigation Equipments

In areas of shallow water levels (1-6 metres head) axial flow or mixed flow pumps are used to lift water. Where water levels are at 6-40 metres head or on river sides, mostly radial flow pumps are used. For deep bore wells, submersible or jet or compressor pumps are used depending on head and discharge requirements and availability of water in the bore well (yield). While the rich farmer banks on costly systems such as electric and diesel pumps to extract groundwater for irrigating their large acres of land, the small and marginal farmer has no option other than using the tedious traditional water lifting devices, such as *tenda, dhekuli, sena, tar* and *don* to irrigate their smallholdings.

Pump Industry

India has about 6 million diesel irrigation pumps and each year some two hundred thousand (2 lakhs) new pumps enter the market. The first electric motor in India was manufactured in Coimbatore in 1930 and thereafter the motor pump industry expanded rapidly there. Today 60 percent of India's requirements of domestic and agricultural pump sets are made in Coimbatore. Besides Coimbatore, Ahmedabad, Baroda, Kolkata and Dewas are the other places where agricultural pump industry is located. Similarly Rajkot, Agra and Kolhapur are famous for oil engines and Rajkot alone accounts for 50 percent of engine production.

a number of departments in the states under the overall control of the Command Area Development Authority.

Shrinking Water Base

Monsoons supply more than 75 percent of India's annual precipitation over a period of less than three months, making storage and transport capabilities critical. Approximately 80 percent of India's water is used in agriculture. Continuing population growth and the predicted impacts of climate change, including shifts in precipitation and glacier melt, make the water challenge graver.

India houses 14 percent of the world's population but has only 4 percent of the total average annual river run-off. Estimates reveal that by 2020, India's demand for water will exceed all sources of supply. At the same time, 70 percent of India's irrigation needs and 80 percent of domestic water supplies come from groundwater. This has lowered groundwater tables and depleted aquifers and is posing grave threats to sustainability.

Water Use Efficiency

With depleting water tables and water related conflicts rising; water use efficiency is becoming a critical parameter in irrigation management. Low water charges realization has resulted in poor finances that in turn hamper operation and maintenance of water infrastructure. Adoption of water saving technologies such as Micro Irrigation Systems: Sprinkler and Drip Irrigation hold promise for increased water use efficiency. While the overall efficiency of surface irrigation is 35 percent, the same with drip irrigation is 80 to 90 percent.

Recognising the inherent potential in these systems the Government has extended a subsidy of 50 percent for implementation of micro irrigation systems. The Government targets 17 million hectares under micro Irrigation by the end of the 11th Five Year Plan period and annual water savings are about 59 billion cubic metres. Other water-use efficiency methods to promote water saving farming systems are System of Rice Intensification, Aerobic rice cultivation, Precision farming, Mulching and Zero tillage.

The Micro Irrigation System market in India is valued at Rs 17 billion in 2009. All water efficient irrigation systems are generally called Micro Irrigation Systems. The main drivers of micro irrigation are factors such as scarcity of water, increasing demand of crop, greater emphasis on horticulture crop and less use of fertilizers. But the high initial cost of micro irrigation System can be a challenge.

Award for Irrigation Technology

The Zayed Future Energy Prize, a global annual award to recognise achievements in the renewable energy industry was bagged by an Indian recently—Amitabha Sadangi, of International Development Enterprises India (IDEI). He was honoured for the successful deployment of low-cost irrigation technology to Indian farmers. This technology has reached over one million farmers and resulted in diesel savings of 533 million litres and a reduction in carbon emissions of 1.8 million tonnes. The Zayed Future Energy Prize jury, selected Amitabha Sadangi as a finalist due to the widespread benefits his technology has provided across India, while promoting environmental conservation. Overall, 5 million people have benefited from the increased income security and environmental well-being.

The merit of drip irrigation technology is that it frees the farmer from the limitations of rain fed farming through out the year with higher cropping intensity and priority farming. It buffers the poor communities against the stresses and shocks due to environmental changes. Drip Irrigation is used successfully among sericulture farmers in south India, watershed projects in south India, cotton farmers in Madhya Pradesh, vegetable growers in Himachal Pradesh, small farmers and landless women in Madhya Pradesh and Rajasthan.

Transition

To conclude, India's irrigation map is in for a transition; the priority is moving to sustainable irrigation management and optimum water use efficiency. Since, 2007 the sector has got a new impetus; innovative methods of irrigation are getting a big push; hike in budget outlays as well as better allocations in the Five Year Plans including 11th Plan period herald a new beginning.

**The writer is Editor of Financing Agriculture*

WATER MANAGEMENT: PROBLEMS AND PROSPECTS

Domestic Demand for Water Outstripping Supply

By **Mohammad Awais and Naheen Haider Zaidi ***

Water is one of the most important natural resources and vital for all living organisms, major ecosystems and their sustainable development. India is an agrarian country and depends a great deal on water for production of food and economic development. India's rural population consumes water mainly for two purposes— domestic use including drinking, sanitation etc and for irrigation.

These two aspects have a direct bearing on the conservation of water and its management. As a finite resource, its over exploitation is fraught with risk and may lead to water- stressed conditions. The present scenario on water resources is critical; especially the status of ground water exploration and its availability. The rural areas are most vulnerable to changes in water resources availability and are least capable of adapting their livelihood to the changes. One should not forget that in India conservation of water and management of resources were well understood and described way back in Varhat Samhita (550 A.D); well organised water pricing system existed in 400 B.C. and construction methods and materials of dams, tanks and spillways were mentioned in ancient books that reveal the significance of water and its management.

Outlook

As per the estimates of Central Ground Water Board, 15 states in India may face severe shortage of ground water if we continue to exploit it indiscriminately. It is increasingly being felt by the government that the needs of the rural people with regard to drinking water and irrigation cannot be fulfilled without launching demand-responsible, community-led and participatory schemes. The prevailing water situation can prove to be a blessing in disguise if it can prod us into adopting an alternative development strategy that is suited to our genius and requirement, and which is protective to people, plants, animals and the environment. In this paper an attempt has been made to study the water management strategies in respect of performance, problems, prospects and its impact on rural masses in India.

The sources of water can broadly be classified into two i.e. surface flows and ground water sources. The surface water and ground water resources of the country play a major role in agriculture, hydropower generation, livestock production, industrial activities, forestry, fisheries, navigation, recreational activities etc.

India accounts for 16 percent of the world human population and 30 percent of the cattle and the country is endowed with just 4 percent of water resources. Estimates indicate that surface and ground water availability is around 1,869 billion cubic metres (BCM). Of this, 40 percent is not available for use due to geological and topographical reasons.

Around 4000 BCM of fresh water is available due to precipitation in the form of rain and snow, most of which returns to the seas via rivers.

Ground Water

About 92 percent ground water extracted is used in the agricultural sector, 5 and 3 percent respectively for industrial and domestic rectors. In India, per capita average annual fresh water availability has reduced from 5,177 BMC in 1951 to about 1,869 BCM in 2001 and estimated to further more down to 1,341 BCM in 2025 and 1,140 BCM in 2050. This is certainly going to be a cause of concern for all of us.

Water covers about three-fourth of the earth's surface and nearly 97.3 percent of earth's water is in oceans and seas. Freshwater constitutes only very small fraction (2.7 percent). Of this freshwater, 75.2 percent lies in frozen form in the Polar Regions and 22.6 percent as ground water. That means very little portion of freshwater is effectively available for consumption. India receives annual precipitation of about 4000 Km^3, including snowfall. Out of this, monsoon rainfall is of the order of 3000 Km^3.

The main water resources in India include rivers, canals, wells and tanks. Apart from the water available in the various rivers of the country, the groundwater is also an important source of water for drinking, irrigation, industrial uses etc.

Table-1. Water Requirement for Various Sectors (in BCM)

Sector	Standing Sub-Committees of MoWR			NCIWRD		
Year	2010	2025	2050	2010	2025	2050
Irrigation	688	910	1072	557	611	807
Drinking water	56	73	102	43	62	111
Industry	12	23	63	37	67	81
Energy	5	15	130	19	33	70
Others	52	72	80	54	70	111
Total	813	1093	1447	710	843	1180

Source: Govt. of India, 2006

The main water resources in India include rivers, canals, wells and tanks. Apart from the water available in the various rivers of the country, the groundwater is also an important source of water for drinking, irrigation, industrial uses etc.

Soaring Demand

As per the recent estimates made by the Govt. of India (2006) on water demand by a) Standing Sub-Committee of the Ministry of Water Resources (MoWR) and b) the National Commission for Integrated Water Resources Development (NCIWRD), their estimates are made till the year 2050. Both of them have triggered warning bells on the intensity of the problem. For estimates by MoWR indicate that, by year 2050, India needs to increase by 5 times more water supplies to industries and 16 times more for energy production, while its drinking water demand will double and irrigation demand will rise by 50 percent.

World Water Day

The United Nations General Assembly has designated 22 March of every year as the World Day for water. This World Day for Water was to be observed starting in 1993, in conformity with the recommendations of UN conference on Environment and Development. The goal is to raise awareness of the world water crisis and their goal of reducing by half the percentage of people who lack access to safe (clean) drinking water and basic sanitation. To address the water-related issues and thereby launch a massive awareness programme all over the country, the Govt. of India declared year 2007 as "Water Year". In 2008, world water day coincided with the International year of sanitation to spur action on a crisis affecting more than one out of three people on the plet. In 2009, the theme for world water day was "Shared water-Shared opportunities".

Planning Needed

As per the international norms, if per-capita water availability is less than 1700 m^3 per year then the country is categorised as water stressed and if it is less than 1000 m^3 per capita per year then the country is classified as water scarce. In India per capita surface water availability in the years 1991 and 2001 were 2309 and 1902 m^3 and these are projected to reduce to 1401 and 1191 m^3 by the years 2025 and 2050 respectively. Hence, there is a need for proper planning, development and management of the greatest assets of the country, viz. water and land resources for raising the standards of living of the millions of people, particularly in the rural areas.

Rural Water Supply

Rural India has more than 700 million people residing in about 1.42 million habitations spread over 15 diverse ecological regions. Providing drinking water to such a large population is an enormous challenge. The challenges become more acute as India is characterised by non-uniformity in levels of awareness, socio-economic development, education, livelihood etc. Water is the key to development and sustenance for all communities. Under conditions of increasing stress on this essential renewable but scarce natural resource, efficient management of water is emerging as a core issue.

Bharat Nirman

Drinking water supply is one of the six components of *Bharat Nirman*, which has been conceived as a plan to be implemented in four years, from 2005-06 to 2008-09 for building rural infrastructure. This will facilitate preparation of a road map for achieving the goal set out under Bharat Nirman for rural drinking water supply by 2008-09. Under Bharat Nirman rural drinking water component, impressive achievements have been made. Year-wise achievements are as follows:

- In 2005-06, against the target of 56,270 habitations to be covered, 97,215 habitations have been covered.
- In 2006-07, against the target to cover 73,120 habitations, 1,07,350 habitation have been covered.

- As per the information received from States/UTs, during 2007-08, 11,457 un-covered and 75,201 slipped-back habitations have been covered and 94,130 quality-affected habitations have been reported to be addressed. Thus, in 2007-08, against the target to cover 155,499 habitations, 180, 788 habitations have been covered.
- During 2008-09, all the remaining habitations, i.e. 18,049 uncovered and 87,279 slipped-back habitations are proposed to be covered. In addition, 1,12,958 quality-affected habitations would be addressed. Thus, during 2008-09, in all 2,18,286 habitations are proposed to be covered.
- Under Bharat Nirman for rural water supply, it was envisaged that during 4 years, Rs. 25,300 crore as Central share would be required. Accordingly, Rs. 4098 crore in 2005-06, Rs. 4,560 crore in 2006-07 and Rs. 6,441.69 crore in 2007-08 has been utilized.

Strategy

In 2008-09, budgetary provision of Rs. 7,300 crore has been made for rural drinking water out of which, Rs. 5,213.37 crore (71.42 percent) has been utilized. Rs. 100 crore additional funds have been provided for safe drinking water in rural schools by installing standalone water purification systems.

Under this innovative scheme following strategies have been developed to implement this scheme.

- Supplementing with new schemes for the habitations served by outlived schemes.
- Rejuvenation of the outlived schemes which are functioning below their rated capacity.
- Providing the regional schemes from alternate safe sources by extending new pipelines.
- Providing rainwater-harvesting structures.
- Reviving the traditional sources.
- Utilising low cost technology for mitigation of quality affected habitations.
- Providing water supply from alternate sources for courage of habitations with no safe source.

Water Policy

The National Water Policy **(1987 and 2002)** adopted by the Indian National Water Resources Council recognises that water is scarce and precious resource and there by outlines the broad principles that govern the management of the country's water resources. The first National Water Policy was adopted in September 1987. However, very little has been achieved in the fulfillment of the objectives laid down in the first policy. Hence, there was

a need to revise the National Water Policy of 1987 and new policy was thus adopted in 2002 with a few more provisions. According to National Water Policy, in the planning and operation of systems, water allocation priorities should be broadly as 1) Drinking water 2) Irrigation, 3) Hydropower, 4) Ecology, 5) Agro-industries, and Non agricultural industries, and 6) Navigation. However, the priorities could be modified or added if warranted by the area/region specific considerations.

The National Water Policy 2002 has assigned the highest priority to drinking water. However, it is important to note that despite five decades of planning and over a decade of 'Drinking Water Missions' there are large numbers of 'no source' villages i.e., those with no identified source of safe drinking water. Interestingly, although the targets for covering such 'no source' villages are repeatedly achieved, their numbers grow, which in turn mean that some covered villages are lapsing back into the uncovered category, and that newer villages are being added to this class.

India needs to revamp its model of drinking water provision. The country needs to tap assured sources and link them within the river basin, if required. Since, provision of drinking water is prime concern, both states and central governments and all stakeholders would support such venture. All this would enable to provision of adequate safe drinking water for all in the country.

Water Management

In view of the existing status of water resources and their increasing demand for meeting the requirements of the rapidly growing population as well as the problems that are likely to arise in future, a holistic, a well planned long term strategy is needed for sustainable water resources management in India. The water resources management practices may be based on the increasing the water supply and managing the water demand under the stressed water availability conditions. Data monitoring, processing, storage, retrieval and dissemination constitute the very important aspects of the water resources management.

Watershed Management

For an equitable and sustainable management of shared water resources, flexible, holistic approach of Integrated Water Resources Management (IWRM) is required, which can cater to hydrological variations in time and space and changes in socio-economic needs along with societal values. Watershed management involves management of land, water, energy and greenery integrating all the relevant scientific approaches appropriate to socio-economic background for the development of watershed.

The main theme behind the watershed management is to minimise the waste of rain water, which flows into the oceans at the cost of socio-economic and ecological conditions of the nations. Local communities play a central role in the planning, implementation and funding of activities within participatory watershed development programmes. In these initiatives, people use their traditional knowledge, available resources, imagination and creativity to develop watershed and implement community-central programme.

Currently, many programmes, campaigns and projects are underway in different parts of India to spread mass awareness and mobilise the general population in managing water resources. There are few successful stories about watershed projects. For instance, *Sukhomajri* in Haryana and *Ralegaon Sindhi Project* in Maharashtra have improved socio-economic conditions considerably in a relatively shorter time.

Community Participation

Community participation and equitable distribution of benefits are the reasons behind their success and sustainability. Rajendra Singh of *Tarun Bharat Sangh* in Rajasthan could replenish a Dead River through successful implementation of watershed concept for which he was awarded Roman Magasaysay award. Anna Hazare in Maharashtra is also famous for his success in water harvesting. Despite some of the above success stories, so far there has been no appreciable improvement on watershed resources utilisation at national level. Undoubtedly, coordinated watershed development programmes need to be encouraged and awareness about benefits of these programmes must be created among the people.

Rain Water

Rainwater harvesting is the process to capture and store rainfall for its efficient utilisation and conservation to control its run-off, evaporation and seepage. Some of the benefits of rainwater harvesting are:

- It increases water availability
- It checks the declining water table
- It is environmentally friendly
- It improves the ground water through dilution, mainly fluoride, nitrate and salinity, and
- It prevents soil erosion and flooding, especially in urban areas.

There is need to recharge aquifers and

conserve rainwater through water harvesting structures. Harvesting rainwater not only reduces the possibility of flooding, but also decreases the community's dependence on ground water for domestic uses. The harvested rainwater is conveyed to agricultural fields through underground pipelines by gravity, thus there is no need of electric or diesel engines. It is ideal solution of solving water problem in area having inadequate water resources.

In this method, the rain from rooftop is fed into tank through a pipe for meeting domestic needs. The building should be designed for this purpose and roof top should be clean and free from dusty pesticides or corrosive materials etc. The water should go through a pipe into a community sump tank, which should be purified before supply. Harvesting of rooftop rainwater could meet over 60 percent of domestic water needs. The potential for rooftop rainwater harvesting has been estimated to be 1 Km^3/yr.

Recycling and Reuse

Recycling means internal use of water by the original user prior to discharge. While reuse refers to wastewater that is discharged from municipalities (75 percent), industries and irrigation are withdrawn by users other than dischargers. After treatment, reclaimed waters are diverted for irrigation. It is clearly evident in major cities where the water scarcity is acute; the municipal sewage water is utilised for irrigating vegetable crops.

Water used for domestic purposes (washing, cleaning and bathing etc.) should be collected, cleaned and recycled for non-drinking domestic and industrial purposes. Nearby holy places and temples the water used for bathing and washing in tanks and ponds should be channelised towards agricultural fields in adjacent areas. It is said that in the city of Franfurt, Germany, every drop of water is recycled eight times.

The total live storage capacity of completed projects in India is about 174 km^3. A large flood storage space in reservoirs is required for a successful flood management programme. Flood management also calls for community participation. Farmers, professional bodies, industries and voluntary organizations have to be aware about flood management.

People's participation in preparedness, flood fighting and disaster response is required. Media like radio, T.V., Newspapers can also play an important role in flood management. As India shares river systems with six neighboring countries, viz. Nepal. China, Bhutan. Pakistan, Bangladesh and Myanmar bilateral cooperation for flood management is necessary for India and the concerned country. The government of India has taken some initiatives in this regard however, more active participation is required.

Groundwater Management

To protect the aquifers from overexploitation, an effective groundwater management policy oriented towards promotion of efficiency, equity and sustainability is required. Agricultural holdings in India are highly fragmented and the rural population density is large. The exploitation of groundwater resources should be regulated so as not to exceed the recharging possibilities, as well as to ensure social equity. The detrimental environmental consequences of over-exploitation of ground water need to be effec-tively prevented by the Central and State Governments. Overexploitation of groundwater should be avoided, es-pecially near the coasts to prevent ingress of seawater into freshwater aquifers. Clearly, a joint management approach combining government administration with active people participation is a promising solution

In critically overexploited areas, bore-well drilling should be regulated till the water table attains the desired elevation. Artificial recharge measures need to be urgently implemented in these areas. Amongst the various recharge techniques, percolation tanks are least expensive in terms of initial construction costs. Many such tanks already exist but a vast majority of these structures have silted up. In such cases, cleaning of the bed of the tank will make them reusable. Promotion of participatory action in rehabilitating tanks for recharging would go a long way in augmenting groundwater supply. Due to declining water table, the cost of extraction of groundwater has been increasing over time and wells often go dry. This poses serious financial burden on farmers.

Hence, special programmes need to be designed to support these farmers. Finally, the role of government will have to switch from that of a controller of groundwater development to that of a facilitator of equitable and sustainable development. Scientists say the hard-rock aquifers have too little storage to justify

the prolific growth in re-charge structures; people say a recharge structure is worthwhile if their wells provide even 1000 m^3 of life-saving irrigation/ha in times of delayed rain. According to a study by T. Shah, the following workable solution for management of groundwater resources:

- Banning private wells is futile; crowd them out by improving public water supply.
- Regulating final users is impossible, facilitate mediating agencies to emerge, and regulate them.
- Pricing agricultural groundwater use is infeasible instead, use energy pricing and supply to manage agricultural groundwater draft.
- No alternative to improved supply side management: better rain-water capture and recharge, imported surface water in lieu of groundwater pumping.
- Grow the economy take pressure off land, and formalize the water sector.

Water Quality

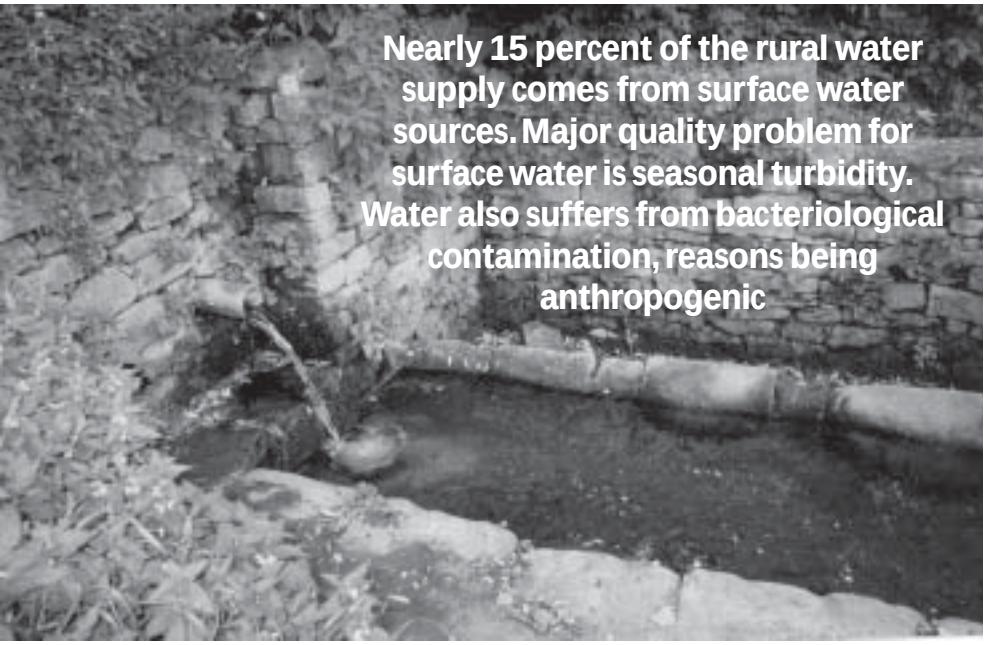
Rural drinking water supply is to a large extent dependent on ground water. Though ground water is less susceptible to pollution as compared to surface water, the nature of quality problem in ground water is of two types (i) it is inherent in the form of contamination caused by the very nature of geological formation, viz. excess fluoride, arsenic, brackishness, iron, etc. (ii) Ground water pollution caused by human intervention (anthropogenic) viz. nitrates.

Nearly 15 percent of the rural water supply comes from surface water sources. Major quality problem for surface water is seasonal turbidity. Water also suffers from bacteriological contamination, reasons being anthropogenic. The reasons for chemical and bacteriological contamination are: poor hygienic conditions around the water sources, improper disposal of sewage and industrial waste water, callous disposal of solid waste, indiscriminate use of chemical fertilizes having high quantity of Nitrates used in the agricultural sector, pollution from industrial effluents (untreated), over-exploitation leading to quality degradation, pollution of the source due to ignorance of the people, over population and lack of public awareness.

Factors in Water Crisis

The overdraw of ground water in the country has led to alarming decline in ground water level in some areas and consequent stress on ground water resources resulting in a great threat to the sustainability of ground water sources. There are many factors responsible for ground water sources becoming defunct and dry, viz-

- Competing demand of ground water for irrigation, industrial and other purposes,
- Excessive drawing of ground water without considering the recharge,
- No or low electricity tariff for agricultural and industrial use,
- Lack of scientific impact and management of ground water,
- Lack of awareness among masses about the need of ground water recharge,
- Misuse of Precious water treating it as a free and everlasting commodity,
- Lack of sustainability principle application in withdrawal of ground water etc.



Measures to Overcome Water Crisis

The following actions have to be initiated on priority basis:

1) Integration of measures for the protection and conservation of potential sources of water supply, including the inventorying of water resources utilisation; protection of mountains and slopes and river banks; and other relevant development and conservation activities.
2) Wherever feasible, artificial recharge and rain water harvesting have to be encouraged instead of looking only for new and distant sources of water supply or tapping vast depleting groundwater.
3) Renovation and utilization of tanks and other local water sources are to be considered as priority task.
4) Integrated watershed development programme should be given priority for soil and water conservation, arresting degradation of catchment areas and restoring ecological balance of the area.
5) New management approaches-empowering people for equitable sharing of water, creating a political will and good governance, developing and sharing knowledge, and technology to improve water resources management.
6) Flood and drought management, including risk analysis and environmental and social impact assessment.
7) A number of reservoir construction projects continuing over the long

Table 2: States affected by various water quality problems

Parameter	Maximum permissible limit	Health impact	Affected states
Fluoride	1.5 mg/l	• Immediate symptoms include digestive disorders, skin diseases, dental fluorosis· Fluoride in larger quantities (20-80 mg/ day) taken over a period of 10-20 years results in crippling and skeletal fluorosis which is severe bone damage	Andhra Pradesh, Assam, Bihar, Chattisgarh, Gujarat, Haryana, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal
Arsenic	0.05 mg/l	• Immediate symptoms of acute poisoning typically include vomiting, oesophageal and abdominal pain, and bloody 'rice water' diarrhea.· Long-tem exposure to arsenic causes cancer of the skin, lungs, urinary bladder, and kidney. There can also be skin changes such as lesions, pigmentation changes and thickening (hyperkeratosis)	Assam, Bihar, Chattisgarh, Jharkhand, Tripura, West Bengal, Uttar Pradesh
Iron	1 mg/l	• A dose of 1500 mg/l has a poisoning effect on a child as it can damage blood tissues • Digestive disorders, skin diseases and dental problems	Arunachal Pradesh, Assam, Bihar, Chattisgarh, Jharkhand, Jammu and Kashmir, Karnataka, Kerala, Manipur, Meghalaya, Mizoram, Madhya Pradesh, Maharashtra, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tripura, Tamil Nadu, Uttar Pradesh, West Bengal, A&N Islands, Pondicherry
Nitrate	100m/l	• Causes Methamoglobinemia (Blue Baby disease) where the skin of infants becomes blue due to decreased efficiency of haemoglobin to combine with oxygen. It may also increase risk of cancer.	Bihar, Gujarat, Karnataka, Gujarat, Haryana, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh
Salinity	2000mg/l	• Objectionable taste to water • May affect osmotic flow and movement of fluids	Adhra Pradesh, Chattisgarh, Gujarat, Haryana, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Pondicherry
Heavy Metals	Cadmium -0.01 mg/ lZinc-15mg/IMercury-0.001mg/l	Damage to nervous system, kidney, and other metabolic disruptions	Gujarat, Andhra Pradesh, Delhi, Haryana, Kerala
Persistent Organic Pollutants	None	High blood pressure, hormonal dysfunction, and growth retardation.	Delhi, Himachal Pradesh, Jharkhand, West Bengal
Pesticides	Absent	Weakened immunity, abnormal multiplication of Cells leading to tumour formation they contain chlorides that cause reproductive and endocrinal damage.	

Source: www.ddws.nic.in, www.cseindia.org

project must be completed on priority basis. Rivers, lakes and wetlands have to be cleaned quickly.

8) Mobilisation of water to water stressed areas particularly in arid and semi arid regions and ensuring drought proofing.

9) Due importance should be given to local water planning, with the basic aim of making each rural area managing its own water needs as far as possible through water harvest, conservation measures and watershed development.

10) There is need for optimum use of local sources of water even in canal irrigated area in the interest of efficiency of water use, extension of irrigated lands, prevention of water logging and increased productivity.

Irrigation

India has the second largest irrigated area in the world, but due to the rapid expansion of irrigation with its emphasis on new construction, irrigation performance and the sector's increasing management needs have not received adequate attention. Irrigation productivity is low. The non-optimal distribution of water results in low yields and cropping intensity and reduced opportunities for diversifying agriculture as do deteriorating infrastructure, limited research on irrigation technology, insufficient piloting of innovations. The sustainability of irrigation investment is put in doubt by a decline in the maintenance of infrastructure and in the quality of construction. Rehabilitation requirements represent an increasing part of construction investment and environmental problems are mounting. Emphasis has therefore been placed on improving irrigation performance.

The value addition by ground water irrigation has been enormous in agriculture. In several regions it has richly contributed to food security. The Food Insecurity Atlas of Rural India revealed that overexploitation of groundwater has reached danger levels in Punjab, Haryana and Tamil Nadu. The Punjab-Haryana region could lose its production potential in a few decades if current patterns of groundwater extraction and pollution, soil salinisation and rice-wheat monoculture persisted. Being a cheap resource, it has been exploited by the farmers quite largely.

Over exploitation of ground water consequently leads to ground water depletion and reduction in water quality as well. Large-scale exploitation of ground water has been leading to high rate of well failure and loss of investments in well irrigation. Flooding the fields over and above the requirement of the crop has become a common practice in many places. One of the foremost and deep-rooted causes for this ominous problem is government's subsidy or no charge for electricity. Uncontrolled depletion of groundwater may well put 25 percent of India's harvest at risk.

Water quality is another major issue. Although in their upper reaches most rivers are of good quality, the importance of water use for cities, agriculture and industries, and the lack of wastewater treatment plants in the middle and lower reaches of almost all rivers cause a major degradation of surface water quality. The sources of water pollution are from industrial effluents, poorly treated sewage, and runoff of agricultural chemicals combined with unsatisfactory household and community sanitary conditions. Among these, agriculture makes a crucial contribution to the pollution of ground and surface water by nutrients and pesticides.

As a consequence of leaching, nitrate and phosphate concentrations in ground water have been rising constantly over past decades. Rising nitrate concentration in ground water as a result of agricultural practices severely affect water supply system. It is not only agricultural practice, with its application of manure and fertilizer that is responsible for nitrate leaching from the soil to ground water but also airborne depositions.

Ground water quality is also being affected by wastewater infiltrating into the sub-soil. Due to the ingress of saline water from coastal regions and polluted water in other areas, water has become unusable. The quality of land and water must be sustained in the face of mounting pressure to degrade these resources through waterlogging, salinisation, groundwater mining, and water pollution.

Water forms the backbone for all the future endeavours to achieve the vision of food security. The projected food requirement in 2050 demands a pronounced role for research, development and training in the water and agriculture sector. Capacity building through technological upgradation and knowledge dissemination will play a pivotal role in translating the vision into reality.

Conclusion

Since water scarcity is a significant problem, every drop of water should be judiciously conserved and its reckless wastage eliminated. Human intervention is vital for halting wastage and harnessing the surplus water to the benefit of water-stressed regions. Unless water problem is adequately addressed with sufficient planning and foresight, the existence living beings will face a grave threat in the time to come.

**The writers are Research Scholars at the Dept of Agricultural Economics and Dept of Geography respectively in Aligarh Muslim University, Uttar Pradesh*

Choupal Saagar with its Customer Friendly Display

RURAL RETAILING IN INDIA

Lessons from ITC's *Choupal Saagar* Experience

By **T. Seshu Kumar ***

Rural Retailing in India is actually non-existent. On what basis do we go about planning a rural retail venture? But then, haven't all of us heard about the story of the Footwear Company Executive who visited Africa and announced that there is a great market potential for because people over there do not wear anything over their feet! This optimism drove us at ITC towards planning our Rural Retailing Venture in 2004.

Market Size

But how big is it? Is it sizeable enough? What are the problems in entering Rural Retail Business? These were some of the issues plaguing us before we set up our first Rural Retail Store at Sehore near Bhopal. The initial news about Rural Retail Potential are heartening. The absolute size of a Rural market is larger than Urban market in many product categories.

The total size of the rural market for FMCG products is Rs 41550.00 as compared to Rs 37130 crores in urban areas. Rural Market share for Consumer Durables Market is 59 percent of the total. An analysis of the rural market shares for about 35 FMCG & Consumer Durables product shows that Rural Market share is higher in about 20 of them.

The first layer is the e-Choupal where farmers have access to Internet at a walking distance, which is supported by Web Portal in local languages operated by a farmer selected from the village

Product Category	Rural Market Share
B&W Tv	81.11
Radio	80.89
Bicycle	77.83
Wrist Watch(mechanical/ Quartz)	75
Sewing Machine	73.51
Fan (Table & ceiling)	60
Cassette Recorder	67.76
Washing Cake	66.88
Washing Powder	57.85
Cooking Oil	65.92
Vanaspati	59.22
Tea	59.85
Toilet Soap	58.43
Cigarettes	57.9
Footwear(casual, leather & sports)	56
Pressure Cooker	52.08
Hair Oil/cream	51.89
Mobike	51.12
Nail Polish	47.85
Moped	47.31
Toothpaste	46.88
Electric Iron	45.66
Packaged Biscuits	43.6
Scooter	37.5
Color TV	36.68
Mixer / Grinder	33.25
Shampoo	32.69
Health Beverage	31.02
Refrigerator	28.19
Washing Machine	16.99
VCR/VCP	8.47

Source: India Demographics Report 2002 by NCAER

Let us look at the rural market share in services:

- In 2001/02, LIC sold 55 percent of its policies in rural India
- Out of 2 million BSNL mobile connections, 50 percent are in Rural India.
- Billing per Mobile in small towns in AP is higher than in Hyderabad.
- The 24 million Kisan Credit Cards (KCC) issued in rural India exceeded 18 million credit-plus-debit cards issued in urban – Rs 64000 crores disbursed under KCC.
- Out of 20 million rediffmail signups 60 percent are from small towns.

An analysis of the Market Potential within 25 Kms catchment for a rural location based in MP revealed that there are about 4,00,000 people / 67,000 households living in this catchment and there is about Rs100 crores of business which happens within the 25 km catchment. Assuming that a new store can target 5 percent market share out of this, a store has potential to do about 5 crores business in a rural area.

Once we decided that the rural market is large enough to set up retail stores , the next question to answer is "Will customers travel distances to buy at a Rural stores"?

Unlike Urban India, rural customers are sparsely distributed across a large area. So the rural consumers would have to travel long distances to reach the store. Are they willing to travel distances?

A study on their current buying pattern showed us that they indeed travel to buy their daily wares. More than 40 percent of the villagers buy their groceries from City/Town and more than 70 percent buy consumer durables, Agri Inputs and Apparel from nearest city/town. Following are the figures on where the consumers buy their different needs.

Distance travelled for buying products is also not a matter of worry: More than 70 percent travel more than 5 kms for buying Consumer Durables, Agricultural Inputs and Apparel whereas about 43 percent travel more than 5 kms for buying Groceries. The economic policy thinking of the government which had decided to spend on Rural Roads substantially over the next decade would only help in making our Superstores more accessible to the customers.

But there are two big issues to tackle:

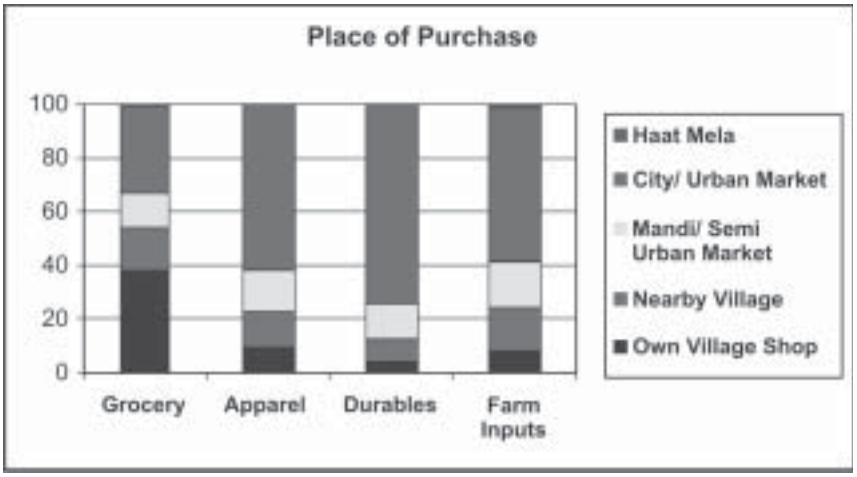
1. **Customer Mindset**: Local Retailers have a very low credibility among rural customers thanks to the rampant availability of fake and look alike products which are sold throughout Rural India. The range available at the local retail stores is also low which pushes the customers to go to the towns to buy their requirements.
2. **Low Modal Incomes**: The second and more important problem is the low modal income of rural customers – unless there is a business model which helps in increasing the income of the customers also – the business will not succeed.

The ITC Model

ITC – IBD has developed a model that attempts to attack both the above issues. This consists of creating a two-layered infrastructure:

The first layer is the e-Choupal where farmers have access to Internet at a walking distance, which is supported by Web Portal in local languages operated by a farmer selected from the village. This infrastructure provides information to farming community on:

- Prices of crops across different mandies and ITC buying price



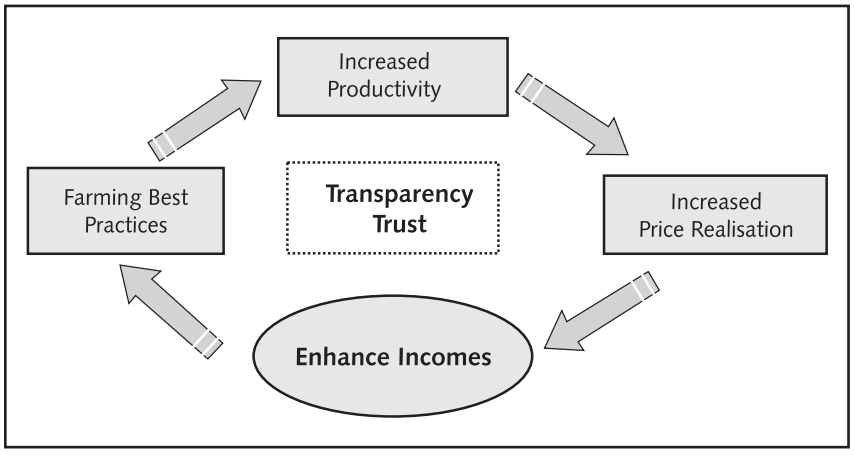
- Crop specific farming best practices
- Weather Information
- Crop related Question and Answers by expert panel.

The e-choupal is a resource of unbiased information which comes free of cost to the villager and thus builds trust among local villagers.

tranparency and trust, ensure higher income to the farmer and makes good quality products and services available at competitive prices.

The promise of Choupal Sagar is encapsulated in its punchline **"*Jaruratein Anek, Jagah Ek*".**

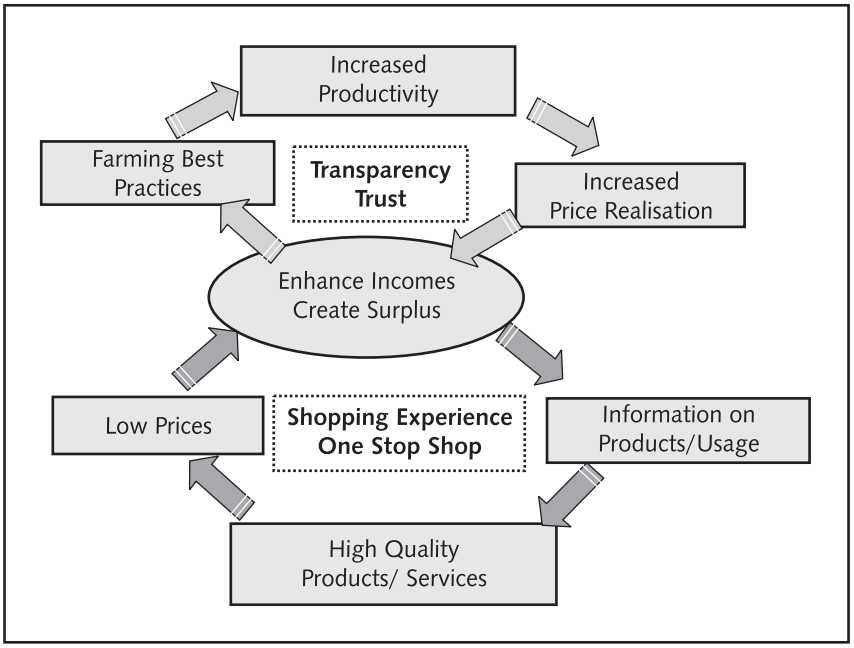
Choupal Sagar is a one-stop physical infrastructure for farmers to



The Second layer is physical infrastructure called Choupal Sagar which consists of a Buying Centre where the farmers can get right price for their produce and a Hypermarket where they can buy goods at competitive prices apart from a whole lot of essential services.

Together the "e-Choupal and Choupal Sagar" infrastructure establish

- Sell their Produce/ Output to ITC Ltd.
- Hypermarket to sell quality products sourced from manufacturers at competitive prices.
- Fuel Station.
- Farmer Training centre for best practices in farming.
- Medical facilities – Doctor and a basic diagnostic laboratory



ITC had set up 24 *Choupal Saagars* over the last 6 years since the first Choupal Saagar opened in August 2004. An average Choupal Saagar has about 300 - 500 customers visiting Choupal Saagars during the Kharif and Rabi buying seasons when commodities are purchased from the farmers

- Restaurant
- Banking and Insurance.

The same strategy extends to hypermarket merchandising that has everything under one roof - from FMCG products to apparel, footwear, consumer durables to agricultural pumps, fertilizers, seeds, pesticides and Fuel.

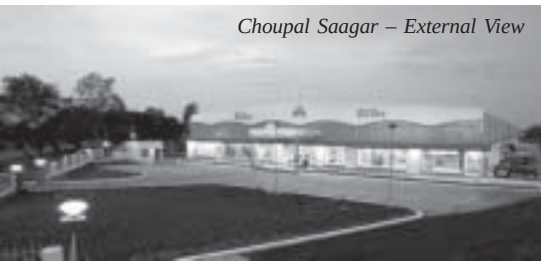
Choupal Saagar Experience

ITC had set up 24 *Choupal Saagars* over the last 6 years since the first Choupal Saagar opened in August 2004. An average Choupal Saagar has about 300 -500 customers visiting Choupal Saagars during the Kharif and Rabi buying seasons when commodities are purchased from the farmers. The buying season is spread from March –May during Rabi Harvest and October to December during Kharif season. Beyond the buying season , about 150 -200 customers visit Choupal Saagars everyday for purchasing their day to day requirements of groceries, household articles, apparel, footwear and even purchases of Consumer Durables for local festivals and marriages.

Challenges in Rural Retailing:

There are three main challenges in Rural Retailing:

a) Diverse Customer Base: While it is true that India is a land of many languages, religions and cultures it is experienced even more when one travels in Rural India.


Choupal Saagar – External View

Varying cropping and irrigation Pattern from district to district results in a matrix of varied prosperity rates in rural areas for almost every 100 kms. The distance from the nearest large town and road connectivity also have an impact on the non-agricultural income as well the aspirations of the consumers.

For example, consumption patterns in fashion categories such as garments and footwear in villages / towns within 50 kms distance from Indore indicate higher spend per household and higher sale of Branded Merchandise where as more prosperous towns but farther from Indore show lesser spend and lesser sale of branded merchandise. The consumption pattern also varies on the basis of different communities that are in the local towns. Towns on the Rajasthan border in MP have a different sales pattern in fashion products due to the migrant population from Rajasthan.


Entertainment during Choupal Mahotsav


Childrens Entertainment during Choupal Mahotsav

b) Smaller Wallet size: While the customers have a lower capability to spend, they still aspire to purchase the same items/ brands that are purchased by their city bred friends and relatives. This creates a contradiction for the retailers – they should supply high quality branded merchandise equivalent to the prices of local products produced without the promise of consistent quality.

c) Media Dark Customers: While the exposure of customers to different media such as Newspaper and TV had been increasing, the ability of these media to influence Customers Consumption Patterns is relatively low as compared to word of mouth and below the line marketing activities.

ITC, under its experience identified different solutions to these challenges:

1) **Flexible, Fast Supply Chain:** The diversity in consumer base and their tastes makes it impossible to predict the requirement of a consumer. The prediction becomes even more complex with the ever changing nature of Indian Monsoons and the agri-commodity prices which make a sea difference in the income of a farmer. A flexible, fast supply chain which is not based on prediction of future trends but based on supplying quickly once the trend is identified is the answer to this challenge.

2) **High Quality, Affordable Merchandise:** ITC had created several firsts in the quality and price of merchandise being sold at Choupal Saagars. Be it Cotton Shirts selling at Rs 129, Plastic Chairs at Rs 199 or Reebok Shoes under Rs 1000, ITC had partnered with several leading companies and exporters to supplying high quality products at prices that are affordable to the customer.

3) **Reach the Customers at their doorstep:** ITC had found that standard communication tools such as mass media are either very expensive or cost ineffective in Rural Marketing. Hence ITC had created its own method of reaching out to rural customers through interactive games, competitions and melas.

Choupal Mahotsav is a mela which is one of its kind in the rural India.


Choupal Mahotsav

Choupal Mahotsav

Choupal Mahotsav is a three day mela targeted towards farmers within 25 km catchment of the Choupal Saagar. ITC had partnered with Impact Communications, Delhi to launch this mega event in Uttar Pradesh during the months of March and April 2010. This 3 day event was conducted at all 8 locations in this state namely Hathras, Chandouli, Hardoi, Budayun, Bahraich, Gonda, Jagdishpur & Pilibit. During these 3 days, farmers and their families were provided opportunities to gain information, shop and entertain themselves at the Choupal Saagars.

Health camps, Food stalls and Service camps were set for the benefit of shoppers and farmers. Sessions on agriculture/farming were handled by experts for enriching the farming community. For the benefit of all family members/age groups, events like magic show, puppet show, folk show and games were lined up. Major brands like Superia, Sunfeast, TVS motors, Bharat Petroleum, JCB, Tata Motors, ACC cement, Eicher tractors, Tata Tea, Moser baer are some of the esteemed companies which participated in the Mahotsav. More than 10000 rural consumers from 200 catchment villages visited each Choupal Saagar during this 3 day extravaganza.

Conclusion: Affordable producer range, customer friendly layout and innovative marketing programmes like Choupal Mahotsav have made ITC Choupal Saagars truly a front runner in Rural Retail Business. However, as Robert Frost said "there are miles to go before we sleep, and miles to go before we sleep….."

The writer is Business Head, Rural Retailing, Agri Business Division, Secunderabad, ITC

Role of *Gramin* Banks in financing Rural Subsistent Farmers

The success of Marathwada Gramin Bank

By **S.K. Deshpande and A.M. Degaonkar ***

The Regional Rural Banks (RRBs) were set up in 1975 by the Government of India in collaboration with State Governments and the Nationalised Banks with the objective to provide financial services to the large underserved and unreached rural population. Although many cooperative and commercial banks were in operation prior to this, they were unable to cater to the savings and credit needs of the rural poor.

The cooperative banks, in spite of having a better geographical coverage in rural areas, were serving mostly the rural rich whereas the commercial bank mainly concentrated in urban areas hence did not target the rural poor. To bridge the gap, the government of India appointed Narashimam Committee in 1975, which recommended the formation of Regional Rural Banks.

Rural Poor

Thus RRBs were established "with a view to developing the rural economy by providing, for the purpose of development of agriculture, trade, commerce, industry and other productive activities in the rural areas, credit and other facilities, particularly to small and marginal farmers, agricultural labourers, artisans and small entrepreneurs, and for matters connected therewith and incidental thereto" (RRB Act, 1976).

The Central Government, State Governments and the Sponsor Banks hold the equity of RRBs in the ratio of 50:15:35 respectively. In the first 15 years, the expansion of RRB peaked to 196 with 14,473 branches, of which more than 80 per cent branches were established in rural areas. It was expected that these banks will become viable in seven to eight years of operations, since their inception. However, by the early nineties many of the RRBs became increasingly unviable resulting in no further expansion and with an increased need for restructuring after almost a decade of debate from 2005.

Need for Awareness

General observations regarding the awareness level on different scheme, farmers are aware about the important saving scheme and their salient features.

According to them, the 'Farmers Club' in the village has made little impact on people to make use of the bank facilities. Similarly, Recurring Deposit scheme has less response mainly for two reasons. One, the income flow is not adequate and regular in villages. Secondly, lack of publicity and promotional activity by the banks. Hence constant persuasion about the product is most important particularly in rural areas.

Indirect Financing

Devraja (2003) studied indirect financing by RRBs in Karnataka. A sample of three Regional Rural Banks namely Cauvery Gramin Bank, Vishverswaraiah Gramin Bank and Kalappaturu Gramin Bank operating in the Southern Karnataka has been selected to analyse the opinion of management regarding loan. Majority of the borrowers (64 per cent) did not prefer loans through primary co – operative societies. Similarly majority of the borrowers (92 per cent) and managers (57 per cent) of the RRBs disfavored the grant of loans through Farmer's Service Societies

Hence in view of this, study on opinion of officials and farmers regarding the financing through Marathwada Gramin Bank (MGB)—a RRB were under taken with following objectives.

1. To analyse the opinion of officials of the Bank regarding the financing.
2. To analyse the opinion of farmers under jurisdiction regarding the financing.

Cluster Analysis

Cluster analysis is a formal multivariate statistical procedure, which is often useful in all the social sciences. The method of maximum similarity measures of cluster analysis was used to analyse the opinion scores given by officials and borrowers of Marathwada Gramin Bank. Opinion scores of the officials and borrowers were obtained on fifteen variables. A correlation matrix of 15 x 15 was developed for identifying maximum similarity values of variables or indicators. The indicators which had the similarity values greater than or equal to X + (0.425 S.D.) were considered as high aggregate cluster. The indicator which had similarity values in between less than X + (0.425 S.D.) and greater than X - (0.425 S.D.) were considered as medium aggregate cluster. The indicator, which had similarity values less than X - (0.425 S.D.) was considered as low aggregate cluster.

$$\text{Standard deviation (S.D.)} = \frac{\{(X - \text{Mean } (X)^2\}^{1/2}}{n^{1/2}}$$

Where, X = Similarity values correlation values.

X = arithmetic mean of the similarity values

n = Number of similarity value

Results

A) *Position of Bank Officials on Financing:* From table 1 it was observed that on the basis of preference the opinion of officials were grouped into high, medium and low aggregate clusters. In regard to high aggregate clusters, similarity measures were restricting greater than or equal to 0.435. In this cluster, the deposit by borrower and advances per branch with similarity measure of 0.575 followed by percent rise in deposit and percent rise in advance with similarity value of 0.443. It implied that opinion of officials was more on deposit by borrower and advance per branch in high aggregate cluster. Hence, this cluster is named as highly preferred dimension.

Similarly, medium aggregate cluster was restricting less than 0.435 and greater than or equal to 0.373. In this cluster opinion of officials on interest paid by borrower and borrowers capacity to repay the loan with similarity measure of 0.429 followed by share capital of bank with similarity measure of 0.428 followed by behavior of bank borrower and loan to priority sector followed by borrower outstanding growth with similarity measure of 0.390. It implied that, opinion of officials was more on interest paid by borrower and borrower capacity to repay the loan in medium aggregate cluster. Hence this cluster is named as medium preferred dimension.

It was also observed from the table that low aggregate cluster was restricting the similarity value less than 0.373. In this cluster opinion of officials on advance to agriculture sector with similarity measure 0.370 followed by advance to co-operative societies with similarity value of 0.353 followed by preferring

Table 1: Aggregate clusters of bank officials with respect to financing

Aggregate cluster	Variable code Numbers	Indicators	Similarity Measures (X)
High (e=0.4352)	2, 5,	Deposit by borrower, Advance per branch.	0.575
	3, 4	Percent rise in deposit, Percent rise in advance.	0.443
Medium (< 0.4352 and e= 0.3728)	8, 11,	Interest paid by borrower, Borrower's capacity to repay the loan.	0.429
	10	Share capital of bank.	0.428
	1, 15	Behavior of bank borrower, Advance per branch.	0.425
	14	Borrowers' outstanding growth.	0.390
Low (<0.379)	6	Advances to agriculture sector.	0.370
	7	Advances to agriculture sector.	0.353
	9	Preferring borrowing at interest rate.	0.342
	12, 13	loss faced by bank, Industrial borrowers' relation.	0.286

Arithmetic mean (X) =0.4040

Standard Deviation (SD) =0.0734

Table 2: Aggregate clusters of farmers with respect to financing

Aggregate cluster	Variable code numbers	Indicators	Similarity measure
High (e=0.4672)	7, 8	Implementation of crop insurance, Housing loan facility for farmer.	0.602
	12, 13	Joint liability group for tenant farmer, Scheme for Jatropha plantation.	0.586
	4, 11	Education about timely repayment of loan, Joint facility for vehicle.	0.571
Medium (< 0.4672 and e=0.3506)	10	Loan facility for other complimentary agriculture business.	0.507
Low (<0.3506)	6	Timely disbursement of agriculture loan.	0.323
	9	Loan facility for sanitation.	0.322
	3	Easy approach for advancing other agriculture loan.	0.308
	14, 15	Loaning for personal loans, Financial assistance for Self Help Group.	0.259
	1,2	Relation of bank officials With farmer, Easy approach for advancing loan	0.200

Arithmetic mean (X) = 0.4089

Standard Deviation (S.D.) = 0.467

borrowing at interest rate with similarity measure of 0.286. Hence this cluster can be known as low preferred dimension.

Opinion of Farmers on Financing: From table 2 it was observed that on the basis of preference the opinion of borrowers were grouped into high, medium and low aggregate clusters. In regard to high aggregate clusters, similarity measures were restricting greater than or equal to 0.467. In this cluster, the implementation of crop insurance, housing loan facility for other complimentary agriculture business with similarity measure of 0.602 followed by joint liability group for tenant farmers and scheme for Jatropha plantation with similarity value of 0.586 followed by education about timely repayment of loan and loan facility for vehicles with similarity measure of 0.571 followed by implementing Kisan Credit Scheme with similarity measure of 0.508. It implied that opinion of borrowers was more on implementation of crop insurance and housing loan facility for farmer in high aggregate cluster. Hence, this cluster is named as highly preferred dimension**.**

Similarly, medium aggregate cluster was restricting less than 0.467 and greater than or equal to 0.351. In this cluster opinion of borrowers on loan facility for other complimentary agriculture business with similarity measure of 0.409 was more in medium aggregate cluster. Hence this cluster is named as medium preferred dimension.

It was also observed from the table that low aggregate cluster was restricting the similarity value less than 0.351. In this cluster opinion of borrowers on timely disbursement of agricultural loan with similarity measure 0.323 followed by loan facility for sanitation with similarity value of 0.322 followed by loaning for personal loans and financial assistance for Self Help Group with similarity measure of 0.259 followed by relation of bank officials with farmer and easy approach for advancing loan. Hence this cluster can be known as low preferred dimension.

**The writers are from Post Graduate Institute of Agribusiness Management, Latur, Maharashtra*

ORGANIC FARMING

Expanding Spread and Global Trends

By **A.V. Tak & V.B. Tak ***

"An organic farm, properly speaking, is not one that uses certain methods and substances and avoids others; it is a farm whose structure is formed in imitation of the structure of a natural system that has the integrity, the independence and the benign dependence of an organism" wrote Wendell Berry in "*The Gift of Good Land*"

Since 1990, the market for organic products has been growing at a rapid pace to reach US$46 billion in 2007.This demand has driven a similar increase in organically managed farmland and people It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

History

The organic movement began in the 1930s and 1940s as a reaction to agriculture's growing reliance on synthetic fertilizers. Sir Albert Howard is widely considered to be the father of organic farming. Further work was done by J.I.Rodale in the United States, Lay Eve Balfour in the United Kingdom, and many others across the world.

Artificial fertilizers were created in the 18th century, initially with super-phosphates and then ammonia derived fertilizers using the Haber-Bosch process developed during World War I. These were cheap, powerful, and easy to transport. Similar advances occurred in chemical pesticides in the 1940s leading to the decade being called 'pesticide era.'

In the developing world, many farms, according to traditional methods which are comparable to organic farming but are not certified. In other cases farmers in the developing world have converted for economic reason. As a proportion of total global agricultural output, organic output remains small, but it has been growing rapidly in many countries, notably in Europe.

Soil Management

Plants need nitrogen, phosphorus, and

potassium, as well as micronutrients and symbiotic relationships with fungi and other organisms to flourish, but getting enough nitrogen, named particularly synchronization so that plants get enough nitrogen at the right time (when plants need it most), is likely the greatest challenge for organic farmers. Crop rotation and green manure ("cover crops") help to provide nitrogen through legumes (more precisely, the Fabaceae family) which fix nitrogen from the atmosphere through symbiosis used for insect and disease control, can also increase soil nutrients, but the competition between the legume and the three crops can be problematic and wider spacing between crop rows is required.

Crop residues can be ploughed back into the soil, and different plants leave different amounts of nitrogen, potentially aiding synchronization. Organic farmers also use animal manure (which must be composted), certain processed fertilizers such as seed meal and various mineral powders such as rock phosphate and greensand, a naturally occurring form of potash which provides potassium. Altogether these methods help to control erosion. In some cases pH may need to be amended. Natural pH amendments include lime and sulfur, but in the U.S some synthetic compounds such as iron sulfate, aluminum sulfate, magnesium sulfate, and soluble boron products are allowed in organic farming.

Mixed farms with both livestock and crops can operate as lye farms, whereby the land gathers fertility through growing nitrogen-fixing forage grasses such as white clover of alfalfa and grows cash crops of cereal when fertility is established. Farms without livestock ("stockless") may find it more difficult to maintain fertility, and may rely more on external inputs such as imported manure as well as grain legumes and green manures, although grain legumes meaty fix limited nitrogen because they are harvested. Horticultural farms growing fruits and vegetables which operate in protected conditions are often even more reliant upon external inputs.

Weed Control

After nutrient supply, weed control is the second priority for farmers. Techniques for controlling weeds have varying levels of effectiveness and include hand weeding, mulch, corn gluten meal. Natural reemergence herbicide, flame, garlic and clove oil, borax, organic acid, polarization (which involves speaking clear plastic across the ground in hot weather for 4-6 weeks), vinegar, and various other homemade remedies are also tried. One recent innovation in rice farming is to introduce ducks and fish to wet paddy fields, which eat both weeds and insects.

Organisms other than weeds which cause problems include arthropods (e.g insects, mites) and nematodes. Fungi and bacteria can cause disease. Insect pests are a common problem, and insecticides, both non-organic and organic, are controversial due to their environmental and health effects. One way to manage insects is to ignore them and focus on plant health, since plants can survive the loss of about a third of leaf area before suffering severe growth consequences.

Avoiding Insecticides

To avoid using insecticides, one can select naturally resistant plants, put bags around the plants, remove dying material such as leaves, fruit and diseased plants, covering plants with a solid barrier ("row cover"), hosing, encouraging and releasing beneficial organisms and beneficial insects, planting companion plants and polycultures, various traps, sticky cards (which can also be used to assess insect prevalence), and season extension. Biological pest control uses natural predators to control pests. Recommended beneficial insects include

Plants need nitrogen, phosphorus, and potassium, as well as micronutrients and symbiotic relationships with fungi and other organisms to flourish, but getting enough nitrogen, named particularly synchronization so that plants get enough nitrogen at the right time (when plants need it most), is likely the greatest challenge for organic farmers

minute pirate bugs, big-eyed bugs, and to a lesser extent ladybugs (which tend to fly away), all of which eat a wide range of pests.

Several of pesticides approved for organic use have been green pesticides such as spin sad and neem. Generally, but not necessarily, organic pesticides are safer and are more environment- friendly than synthetic pesticides. The main organic insecticides used in the U.S are Bt (a bacterial toxin) and pyrethrum. Less toxic but still effective organic insecticides include neem, spinosad, soaps, garlic, and citrus oil, Capsaicin (repellent), Bacillus papillae, Bavaria bassinet, and boric acid.

Certification

Standards regulate production methods and in some cases final output for organic agriculture. Standards may be voluntary or legislated. In the 1970s organic producers could be voluntarily certified by private associations. In the 1980s, governments began to produce organic production guidelines. Beginning in the 1990s, a trend toward legislation of standards began, most notably with the 1991 EU-Eco-regulation developed for European Union which set standards for 12countries, and a 1993 UK programme. The EU programme was followed by a Japan programme in 2001, and 2002 the United States created the National Organic Programme (NOP).

Under USDA organic standards, manure must be subjected to proper hemophilic composting and allowed to reach a sterilising temperature. If raw animal manure is used, 120 days must pass before the crop is harvested if the final product comes into direct contact with the soil for products which do not come into direct contact with soil, 90 days must pass prior to harvest

Economics

The economics of organic agriculture encompasses the entire process and effects of organic farming in terms of human society, including social costs, opportunity costs, unintended consequences, information asymmetries, as economies of scale. Although the scope of economics is broad, agricultural economics tends to focus on maximizing yields and efficiency at the farm level. Mainstream economics takes an anthropocentric approach to the value of the natural world biodiversity, for example, is considered beneficial only to the detent that it is valued by people and increases profits. Some governments such as the European Union subsidize organic farming, in large part because these countries believe in the external benefits of reduced water use, reduced water contamination by pesticides and nutrients of organic farming, reduced soil erosion.

Reduced carbon emissions, increased biodiversity, and assorted other benefits.

Organic farming is labour and knowledge-intensive whereas conventional farming is capital-intensive, requiring more energy and manufactured inputs. Organic farmers in California have cited marketing as their greatest obstacle.

Distribution

The markets for organic products are strongest in North America and Europe, which in 2001 was estimated to be US$6 and US$8 billion respectively in the total US$20 billion market. However, as of 2007 organic farmland is distributed all across the globe. Australasia has 39 percent of the total organic farmland with Australia's 11.8 million hectares, but 97 percent of this land is sprawling rangeland (2007), which results in total sales of approximately 5 percent of US sales; Europe has 23 percent of total organic farmland (6.9 million hectares), followed by Latin America with 19 percent (508 million hectares). Asia has 9.5 percent while North America has 7.2 percent. Africa has a mere 3 percent.

Besides Australia, the countries with the most organic area are Argentina (3.1 million hectares) China (2.3million hectares), and the United States (1.6 million hectares). Much of Argentina's organic farmland is pasture, like that of Australia. Italy, Spain, Germany, Brazil, Uruguay, and the UK follow the United States in terms of the amount of land managed organically.

Productivity

A 2006 study suggests that converted organic farms have lower pre-harvest yields than their conventional counterparts in developed countries (92 percent and that organic farms have higher pre-harvest yields than their low-intensity counterparts in developing countries (132%). The researcher attributes this to a relative lack of expensive fertilizers and pesticides in the developing world compared to the intensive, subsidy-driven farming of the developed world. Nonetheless, the researcher purposely avoids making the claim that organic methods routinely outperform green-revolution (conventional) methods. This study incorporated a 1990 review of 205 crop comparisons which found that organic crops had 91 percent of conventional yields. A major US survey published in 2001, analysed from 150 growing

seasons for various crops concluded that organic yields were 95-100 percent of conventional yields.

Impact

Organic methods often require more labour and provide rural jobs but increasing costs to urban consumers. Agriculture in general imposes external costs upon society through pesticides, nutrient runoff, excessive water usage, and assorted other problems. As organic methods minimise some of these factors, organic farming is believed to impose fewer external costs upon society.

A 2000 assessment of agriculture in the UK determined total external costs for 1996 of 2343 million British pounds of 208 per hectare. A 2005 analyses of these costs in the USA concluded that cropland impulses approximately US$5 to US$16 billion dollars, while livestock production imposes US$714 million.

Both studies concluded that more should be done to internalize external costs, and neither included subsidies in their analyses, but noted that subsidies also influence the cost of agriculture to society.

Quality

Organic food is widely believed by the lay public to be healthier than conventional food, although the researches inconclusive. Animals fed organic diets appear to have slightly better health and reproductive performance, but similar tests in humans have not been performed. In some vegetables and cereals there is a lower concentration of protein, but it is of higher-quality, Nutrients appear to be similar with the exception of a trend towards slightly higher vitamin C in organic food.

Only tentative conclusions can be drawn of the relative safety of organic food. Organic produce is likely to have less agrochemical residues, but these residues are generally below the acceptable daily intake and their health impact is questionable. Organic fold also appears to have nitrate concentrations but the health impact of nitrates is debated. Both organic and conventional food is expected to have similar concentrations doff persistent organic pollutants and heavy metals. Data is limited on natural plant pesticides and their health effects,

as well as the relative risks from bacterial pathogens.

Concerns have been raised that the higher expense of organic food (ranging from 45 to 200 percent) could limit the recommended consumption of 5 servings per day of vegetables and fruits, which are known to improve health and reduce cancer regardless of whether they are organic or conventional.

Two studies have found that children fed organic diets experienced significantly lower organ phosphorus pesticide exposure than children fed conventional diets. Although the researchers did not collect health outcome data in this study, they concluded "it is intuitive to assume that children whose diets contest of organic food items would have a lower probability of neurologic health risks".

A 2007 study found that consumption of organic milk is associated with a decrease in risk for eczema, although no comparable benefit was found for organic fruits, vegetables or meat. Extensive scientific research is being carried out in Switzerland at over 200 farms to determine differences in the quality of organic food products compare4d to conventional in addition to other tests. The FiBL institute has been investigating the differences at over 200 farms.

It states that "organic products stand out as having higher levels of secondary plant compounds and vitamin C. In the case of milk and meat, the fatty acid profile is often better from a nutritional pointy of view. As far as carbohydrates and minerals are concerned, organic products are no deferent from conventional products. However, in regard to undesirables such as nitrate and pesticide residues, organic products have a clear advantage. A 12 million EU-funded investigation into the difference between organic and ordinary farming published in 2007 found that organic fills have more nutritional value. A recent study found that organically grown produce has double the flavonoids, an important antioxidant. A 2007 study found that organically grown kiwifruit had more antioxidants than conventional kiwifruit.

Avoids GM Products

A key characteristic of organic farming is rejection of genetically engineered products, including plants and animals. On October 19, 1998, participants at IFOAM'S 12th Scientific Conference issued the Mar del Plata Declaration, where more than 600 delegates from over 60 countries voted unanimously to exclude the use of genetically modified organisms in food production and agriculture. From this point, it became widely recognized that GMOs are categorically excluded from organic farming. Although opposition to the use of any transgenic technologies in organic farming is strong, agricultural researchers Luis Herrera-Estrrella and Ariel Alvarez-Morales continue to advocate integration of transgenic technologies into organic farming as the optimal means to sustainable agriculture, particularly in the developing world.

Biodiversity

A wide range of organisms benefit from organic farming, but it is unclear whether organic methods confer greater benefits than integrated agric environmental conventional programmes. Nearly all non-crop, naturally occurring species observed in comparative farm land practice studies show a preference in organic farming both by population and richness. Spanning all associated species, there is an average of 30 percent more on organic farms versus conventional farming methods. Birds, butterflies, soil microbes, beetles, earthworms, spiders, vegetation, and mammals are particularly affected. Organic crops use little on herbicides and pesticides and thus biodiversity fitness and population density are benefited. Many weed species attract beneficial insects that improve soil qualities and forage on weed regarded as one way to minimize erosion. However, a recent study by the USDA's Agricultural research Service has found that manure applications in organic farming are better at building up the soil than no-till despite tillage.

Resists Climate Change

Anthony Melissa argues that organic agriculture with its emphasis on closed nutrient cycles, biodiversity, and effective soil management has the capacity to mitigate and even reverse the effects of climate change. According to the Rodale Institute, which has been comparing organic agricultural systems and conventional systems since 1981, organic agriculture also can be used to mitigate global warming by decreasing fossil fuel emissions and sequestering carbon in the soil. The elimination of synthetic nitrogen in organic systems decreases fossil fuel consumption by 33 percent (LaSalle) and carbon sequestration takes CO2 out of the atmosphere by putting it in the soil in the form of organic matter which id often lost in conventionally managed soils. Carbon sequestration occurs at especially high levels in organic no till managed soil according to the Ridale Institute.

Sales and Marketing

Organic farmers often report that marketing and distribution are hard. Most of organic sales are concentrated in developed nations. These products are what economists call good kin as they rely on uncertain certification. As food prices rise, organic products may experience a decrease in quantity demanded. A 2008 survey by WSL Strategic Retail found that interest in organic products had dropped since 2006, and that 42 percent of Americans polled do not trust organic produce. The Hartman Group reports that 69 percent of Americans claim to occasionally buy organic products, down from 73 percent in 2005. The Hartman Group says that people may be substituting local produce for organic produce.

**The writers teach at M.A.U Parbhani in Maharashtra*

GLOBAL WARMING
Challenges to Sustainable Development

"Preserve Forests and Plant more Trees"

By **D. Muthamizh Vendan Murugavel ***

Burning fossil fuels releases billions of tonnes of carbon dioxide that has been locked away in the Earth for millions of years

The climate is changing. The earth is hotting up; and there is scientific consensus that it is happening, and human-induced. With global warming on the increase and species and their habitats on the decrease, chances for ecosystems to adapt naturally are diminishing. Many are agreed that climate change may be one of the greatest threats facing the planet. Recent years show increasing temperatures in various regions, and/or increasing extremities in weather patterns.

Scientists use "global warming" in a precise way, to mean "a tendency for the globe to warm over a given period". There is a great deal of scientific study focused on climate change and the majority of scientists agree that the average global temperature is increasing. The temperature of the globe has fluctuated since the very beginnings of our planet. The real problem is not just the fact that it is warming, but the rate at which it is warming.

Hot Decade

Global temperatures started rising radically in the last 12-year period between 1997 and 2008. The rate at which the planet is warming is possibly the single biggest challenge to ever face humanity. There are quite a few trace gases, such as; Argon, Carbon Dioxide, Neon, Helium, Methane, Hydrogen, Nitrous Oxide and Ozone. These gases are often called 'green house gases' because during the day the earth soaks up heat, and these gases act like a greenhouse trapping in the heat.

The proportion of greenhouse gases has increased significantly since the Industrial Revolution. Humans began burning fossil fuels, (particularly coal) in a big way, to drive steam engines for industry, and generate electricity. When fossil fuels are burnt or combusted, carbon dioxide, methane and nitrous dioxide are given off as gases. In addition to escalating coal use after the Industrial Revolution, came the widespread use of another fossil fuel; petroleum for transport.

At the beginning of the 20th century, annual global oil output was about 150 million barrels of oil, now, that amount is extracted globally in just two days. Burning fossil fuels releases billions of tonnes of carbon dioxide that has been locked away in the Earth for millions of years. Humans are adding billions of tonnes of carbon dioxide to the atmosphere each year.

Not only is the climate beginning to change but this is the first factor in a downward spiral of events. As a result of the higher temperatures, the sea levels throughout the world are rising. As the temperatures become warmer and warmer the glaciers are beginning to melt more and more in the Arctic and then causing the sea levels to rise. Statistics are showing that the ocean levels will rise by at least 3 feet in the future and this is enough to wipe out many of the subtropical islands of the world.

Crucial Facts about Global Warming

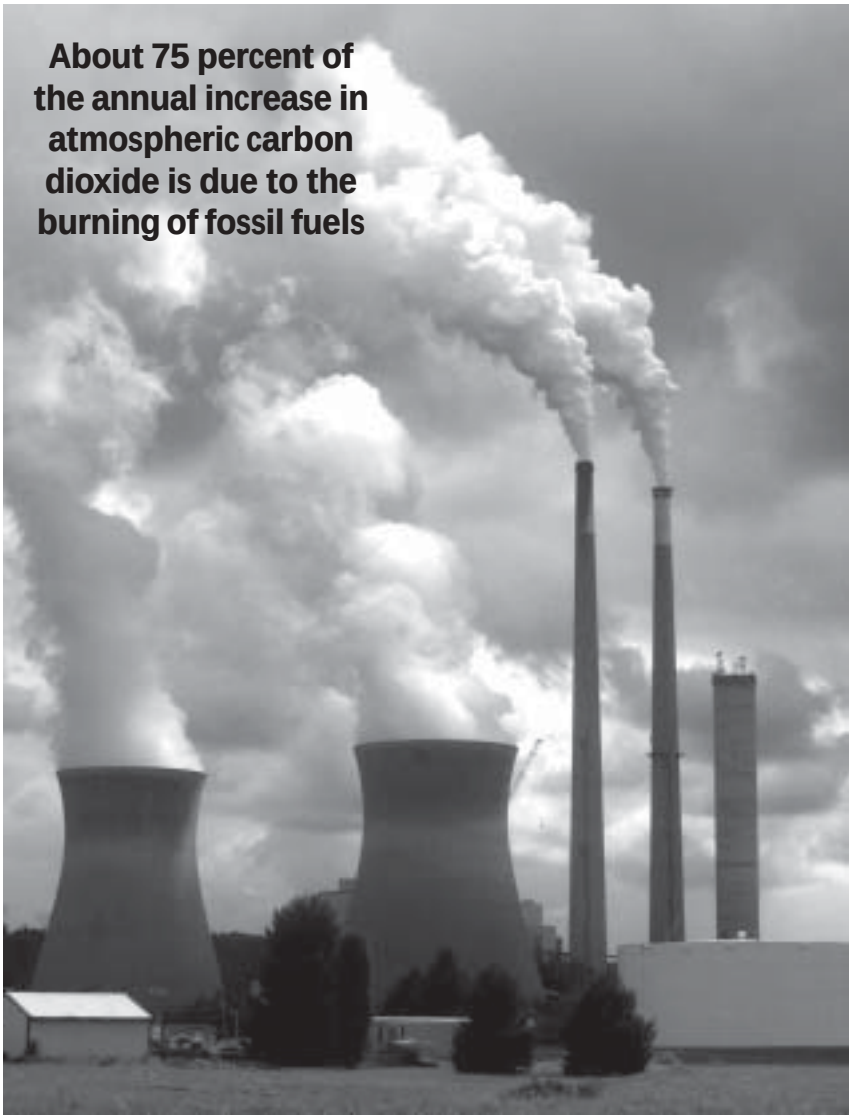
- The world's population is currently increasing at the rate of about 80,000,000 per year (about 1.2 %).
- The current world population is 6,781,000,000 (September 1, 2009).
- The global fleet of motor vehicles is estimated at 830,000,000 (2006).
- The global fleet of motor vehicles has been recently growing at the rate of 16,000,000 per year.
- Motor vehicles (cars, trucks, buses, and scooters) account for 80% of all transport-related energy use.
- The concentration of carbon dioxide in the atmosphere, which was at 290

Global Warming

The spurt in global warming is causing sea levels to rise and also change in the amount and pattern of precipitation, including expansion of subtropical deserts. The continuing retreat of glaciers, permafrost and sea ice is expected, with the Arctic region being particularly affected. The other regions also likely to be effected by shrinkage of the Amazon rain forest and Boreal forests, increases in the intensity of extreme weather events like Tsunami and Hurricanes, species extinctions and changes in agricultural yields.

Adverse Results

The impacts of global warming are likely to hit developing countries hardest. Global warming threatens availability of fresh water, food security and productivity of natural resources. Water-borne and vector-borne diseases pose a special threat to regions with inadequate health infrastructures. Coastal zones could be severely damaged by erosion and sea-level rise, while areas prone to desertification will experience intensification of that problem. Tropical monsoons and cyclones could become more intense, threatening Asia's crop production, biodiversity and human health. Latin America, with its high concentrations of biodiversity and dependence on natural resources, faces similar threats. Low-lying regions everywhere are threatened with inundation by sea-level rise.



ppm in the year 1900, rose to 316 ppm in 1959, or at an average 0.44 ppm per year.

- Measurements of the concentration of carbon dioxide since 1959 (316 ppm) have revealed an increase to 387 ppm in 2009, or at an average 1.42 ppm per year.
- The concentration of carbon dioxide has increased an average of about 1.8 ppm per year over the past two decades.
- The concentration of carbon dioxide increased 2.87 ppm in 1997-98, more than in any other year of record.
- The year 1998 was the warmest of record. The year 2002 was the second warmest (to that date). The year 2003 was the third warmest (to that date). The year 2004 was the fourth warmest (to that date). The year 2005 equaled 1998 as the warmest of record. The year 2007 equaled 1998 as the second warmest of record. The ten warmest years have occurred in the twelve-year period 1997-2008.
- About 75 percent of the annual increase in atmospheric carbon dioxide is due to the burning of fossil fuels.
- The remaining 25 percent is attributed to anthropogenic changes in land use, which have the effect of reducing the net uptake of carbon dioxide.
- Anthropogenic changes in land use occur when forests are converted to rangelands, rangelands to agriculture, and agriculture to urban areas.
- Other patterns of land degradation-deforestation, overgrazing, overcultivation, desertification, and salinisation-reduce the net uptake of carbon dioxide, indirectly contributing, however slightly, to global warming.

Most of the global warming statistics are focused on the period up to year 2100. However, global warming is expected to continue beyond year 2100, even if the emissions stop, the global warming will continue to increase because of the large

heat capacity of the oceans and the long lifetime of carbon dioxide (co2) in the atmosphere.

Sustainable Development

The idea of sustainable development grew from numerous environmental movements in earlier decades. Summits such as the Earth Summit in Rio, Brazil, 1992, were major international meetings to bring sustainable development to the mainstream. However, the record on moving towards sustainability so far appears to have been quite poor. The issues of sustainable development have become relevant today not only in developing countries but also in developed or advanced countries where the imbalance in natural environment is consciously felt due to extraordinary emission of CO2 which has impact on climate. The climate change is causing unpredictable changes in weather conditions. Some of such events have devastating impact on human habitat. This is experienced by frequency of cyclone, flooding and natural calamities on different parts of the world.

Successful sustainable growth and expansion involves a wide ranging knowledge of guiding principles and issues over and above an objective understanding of scientific and economic certainty. We all need to focus and participate in various educational programs in order to convey awareness and knowledge. We need to take a proactive approach with the environment. Essential requirement here is a clear conceptual frame work to promote sustainable development in way that predictable adverse effect are mitigated and unknown future challenges are met with and converted into opportunities for removing poverty.

Industrialised countries must provide leadership by adopting policies to reduce greenhouse gas emissions, develop needed technology, and provide new and additional resources to help developing countries achieve sustainable development while managing their own emissions.

Conclusion

Life cannot exist without green house gases like carbon dioxide, water vapour, methane etc, but they should be existing in permissible quantities only. The problem of global warming can be stopped when Government, industries and people cut contributing abundant amount of green house gases which traps more heat in the atmosphere thus increasing the temperature. Awareness among people about this most dangerous issue is very much needed. More than all, many trees should be planted as they absorb carbon dioxide and also existing forests should be saved.

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COST OF MILK PRODUCTION

A Case Study from Maharashtra

By **Vijay Gorakh Patil ***

The random sample survey study on the 50 dairy farmers from eight villages of Shirpur Tehsil of Dhule District of Maharashtra (India) was undertaken to estimate the cost of production of milk in the area of study. The total cost of milk production per cow/buffalo was Rs. 113.87 in which the variable cost was 83.76 percent (Rs. 95.38) and remaining Rs.16.24 percent (Rs. 18.49) was fixed cost. In variable cost, the cost of feed stuff was 73.39 percent (Rs. 70). Labour cost was 15.73 percent (Rs. 15.00), the cost of medical treatment was 2.62 percent (Rs. 2.50) and interest on working capital was 8.26 percent (7.88). Finally it was found that the cost of milk was Rs. 9.10 per liter in the study area.

Dairy farming is an important source of income and more remunerative in comparison to crop production in India.

Milk production in India is predominantly the domain of small farmers in mixed farming system. Scientific dairy management helps the farmer to channelise his limited resources to maximise returns from his dairy farm.

The importance of dairying lies not only in products but also it brings about significant changes in socio-economic structure of the rural economy. The National Commission on Agriculture (1976) has observed dairying as an additional enterprise for improving the status of rural masses especially weaker sections consisting of small medium and landless labourers. It is therefore, essential to examine the production cost of milk.

Modus Operandi

In this research, the investigator studied the production cost of milk at farmer level in Shirpur Tehsil of Dhule District in Maharashtra. The investigator selected 50 dairy farmers from eight villages from Shirpur Tehsil District Dhule. In the questionnaire the questions related to the

Cost of milk production

Table No.1

S.N.	Particulars	Milk Production Cost (Rs.)	Percentage to Total
1	Fixed Cost		16.24
a)	Depreciation on cattle shed	1.66	08.98
b)	Depreciation on Livestock	8.33	45.05
c)	Depreciation on Misc. Expenses	1.00	05.40
d)	Interest on Fixed Cost	7.50	40.57
	Total Fixed Cost	18.49	100.00
2	Variable Cost		83.76
a)	Cost of feed stuff	70.00	73.39
b)	Labour Cost	15.00	15.73
c)	Cost of treatment	02.50	2.62
d)	Interest on working capital	07.88	8.26
Total of Variable Cost		95.38	100.00
Total Cost of Production		113.87	-
Value of dung		10.00	-
Net Cost of Production		103.87	-
Milk Production Per day (Lit)		12.5	-
Per Liter Cost of Production		9.10	-

fixed cost and variable cost were stated and distributed to the dairy farmers to collect primary data. The collected data was analysed using the statistical tool percentage and conclusions were drawn.

Data Collection

The largest section of Indian population is engaged in agriculture. However, the earnings from agriculture as an occupation may not fully meet the needs of an individual, as the pressure on land holding is mounting day by day because of the high growth of population. So, a subsidiary source of income is necessary to deal with the situation, so that our farmers can achieve enough food security. Majority of Indian farmers have adopted animal husbandry as a subsidiary occupation. Dairying is recognized as the best alternative to provide employment to the rural people to improve their living conditions. Dairy enterprises provide ready cash in hand to rural households to meet their daily requirements. Therefore, it was essential to bring the cost structure of milk production in the open to the benefit of the dairy farmers thanks to which they can decide at what price the milk should be sold. The investigator also paid focus on what the farmers should understand in terms of reducing input cost and increase the profits in dairy farming.

The findings of the study would help to understand the cost of production of milk among the dairy farmers of Shirpur Tehsil and in turn help them to minimise the input cost in growing high yielding fodder crops. The study is also intended to minimise the input cost in terms of medical expenses by maintaining hygienic conditions.

Primary data was collected from the randomly selected farmers from eight villages of Shirpur Tehsil. A structural interview schedule, consisting of relevant questions related to the objectives of the study was prepared. Precaution was taken to keep the language simple so as to get desired responses from the respondents. The interview schedule was developed in Marathi (local language) for better understanding. It contained questions related to the cost of milk production, cost of feed etc.

Pre-testing

Then the Interview schedule was pre-tested for accuracy, simplicity and practicability with a group of 10 dairy farmers in village Dahiwad. Considering the experience of pre- testing, related questions were put together to ensure

Dairying is recognized as the best alternative to provide employment to the rural people to improve their living conditions. Dairy enterprises provide ready cash in hand to rural households to meet their daily requirements

consistency in response. The language of a few questions was modified for ease in understanding and eliciting accurate response, for which sufficient number of copies of interview schedule were prepared for collection of data. The primary data was collected personally from the sample respondent by adopting personal interview method. The respondents were contacted at their time on farm as per their convenience. The rapport was established by explaining them the objective of study.

Tabulation

The data was analysed on the basis of specific objectives of the study and hypothesis formulated for the study. The data in the primary table were used for the categorisation of parameters according to the objective of the study, preparation of secondary table and the application of statistical tools.

The statistical tools used in the present research study were Arithmetic mean, percentage.

Result and Discussion

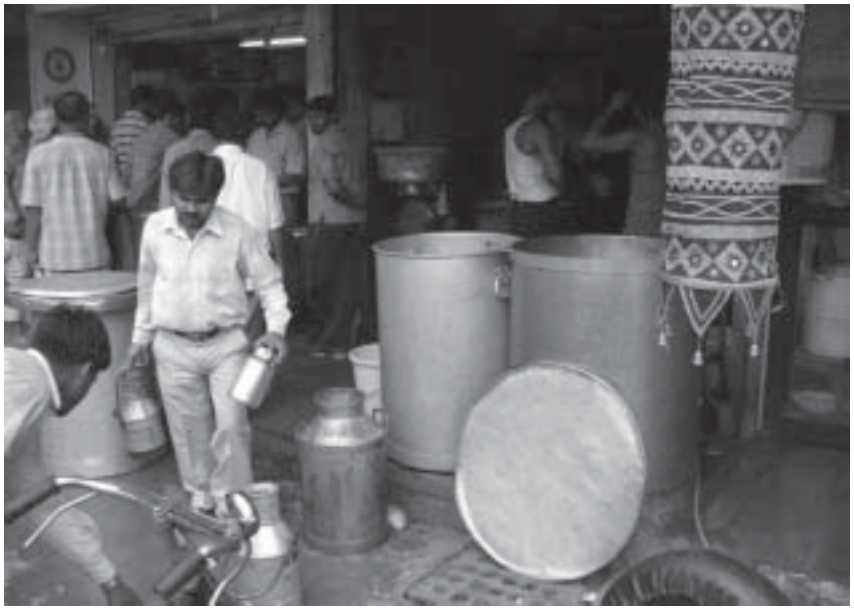
Research methodology of this study is presented in the following subheads.

Main Costs of Production

a) Fixed Cost b) Variable Cost.

Fixed cost, includes i) Depreciation on shed ii) Depreciation on Live Stock iii) Depreciation on miscellaneous items and iv) Interest on fixed capital. Variable cost includes. i) Cost of feed stuff ii) Labour cost iii) Cost of treatment and iv) Interest on working capital. The cost of milk production was Rs. 9.10 per liter in the study area.

The total cost of milk production per farm was Rs. 113.87 in which the variable cost was 83.76 percent (Rs. 95.38) and remaining 16.24 percent (Rs. 18.49) was fixed cost. In variable cost, cost of feed stuff was 73.39 percent (Rs.70), Labour cost was 15.73 percent (Rs. 15.00), the cost of treatment was 2.62 percent (Rs. 2.50) and interest on working capital was 8.26 percent (Rs. 7.88). From above discussion it is concluded the cost of labour and cost of feed stuff was the main component in the production of milk in the study area.



The Cost of milk production was 9.10 per liter in the study area. The total cost of milk production per farm was Rs. 113.87 in which the variable cost was 83.76 percentage (Rs. 95.38) and remaining 16.24 percentage (Rs.18.49) was fixed cost.

Conclusion

The variable cost was the main component of the cost of production. In variable costs, the cost of feed stuff and the cost of labour are the main components in the study area. Therefore the efforts should be made so that farmers spare some of their land in the cultivation of the fodder and proper management of labour.

Implications

The study analysed the cost of milk production which will help the dairy farmers to minimise the variable cost and to increase the profit. The investigation made it clear that low price is the major problem affecting the farmers. So it will help dairy farmers to produce such a quality of milk which will be given high price. The study would be helpful to the dairy farmers for employment generation. The findings of the study would be helpful to the dairy farmers in making decision "At what cost the milk should be sold?" The findings of the study would also be helpful to dairy in reducing input costs.

***The writer is a** Ph. D. Research Fellow at YCMOU, Nasik*

Economic Gains of Bivoltine Cocoon Production

By **Dr. S. Lakshmanan ***

Introduction

In the wake of Globalisation, Liberalisation and Privatisation (GLP) of Indian economy, Indian agriculture has been moving way from traditional bound agriculture to crop diversification and commercialization. Marginal and small landholders prefer to cultivate less-investment and family-labour oriented agriculture and its allied crops.

It is partly due to considerable variations in both the total quantity and distribution of rainfall in the recent past; and declining profitability in the traditional agriculture owing to increasing cost of production. Like agriculture, sericulture is also facing problems like increasing cost of production and non-availability of hired labour for cultivation of mulberry and rearing of silkworms. In spite of such shortcomings, farmers continue to produce bivoltine silk cocoons in Southern parts of India.

Sericulture in Tamil Nadu

Of late, Tamil Nadu has become a model state for production of bivoltine silk in the country after popularisation of bivoltine sericulture technology in the field under Japanese Co-operation International Agency (JICA). The state has increased the quantity of bivoltine cocoon production from 0.052 lakh kg in 1999-2000 to 19.240 lakh kg in 2006-07, contributing around 24.26 per cent of total silk production. Similarly, for the same period, the average bivoltine cocoon yield/100 dfls increased from 35.230 kg to 60.410 kg, showing 72 per cent yield increase.

The impact of JICA project showed that farmers could rear bivoltine in the Indian

Tamil Nadu has become a model state for production of bivoltine silk in the country after popularisation of bivoltine sericulture technology in the field under Japanese Co-operation International Agency (JICA)

conditions. The technologies developed under the JICA project are suitable and sustainable for promotion of bivoltine in India.

Technologies

The farmers have become competent enough to adopt the new technologies such as high yielding mulberry varieties (V_1 and S_{36}) and bivoltine silkworm hybrids (CSR_2 x CSR_4; CSR_4x CSR_5) and are able to produce quality silk of 2A-4A grade silk.

Although cultivation of high-income oriented crops, such as sugarcane, turmeric and banana are major crops in Erode district of Tamil Nadu, bivoltine sericulture has become one among important commercial crops in the district after implementation of JICA project in the region. The cultivation of mulberry and silkworm rearing offers periodical income and assures full-time family labour employment throughout the year. *(Balasarswathi et al., 2006 and Lakshmanan et al., 1998 and 2007)*

In Tamil Nadu, Erode district has been considered as having highly potential for production of bivoltine cocoons. As increasing cost of inputs is a major limitation for the agricultural crops as well as sericulture, it has become necessary to find out the cost of production and return in sericulture as compared to other important commercial crops. This study assumes greater significance as there are no empirical studies conducted at the farmer's level on cost of production and returns of bivoltine sericulture with other competing agricultural crops after implementation of JICA project in Tamil Nadu.

Study Region

Gobichettipalayam taluk of Erode district in Tamil Nadu has been selected for the present study. This taluk has been considered as a major bivoltine cocoon-producing center in the district. The study was conducted in four villages. From each village 15 farmers, were selected randomly. Thus, the study constituted a total sample size of 60 farmers. All the selected farmers reared bivoltine silkworms as well as cultivated agricultural crops, such as sugarcane, turmeric and banana. A simple tabular method was used to find out cost of cultivation and returns in sericulture and other agricultural crops. The results are presented per acre/year. The study refers to agricultural period 2005-06.

Economics of Bivoltine Sericulture

The empirical findings on cost of production of bivoltine cocoon are presented in Table 1. The total cost of cocoon production per acre/year worked out to Rs.67420.10 of which, the cost of human labour alone to the extent of Rs.27,343.62. Next to human labour, the critical inputs (farmyard manure, fertilizer and irrigation) together shared Rs.13,463.72. It was also observed during the field study that the availability of hired labour force has become a scarce resource for sericulture activities in the region due to intensive cultivation of other agricultural crops; and frequent labour migration to near by towns for seeking higher wages employment. In spite of such problems, farmer's continued to rear silkworm rearing due utilization of family labour and engaging hired labour during fifth stage, mounting and cocoon harvesting.

Unlike other agricultural crops, cocoon production could be round the year activity. On an average, 6 crops can be harvested under irrigated condition during one year. In other words, for every two months, earnings can be realised through sericulture. The gross income obtained from sericulture was Rs.120703.92 (see Table 2) and input- output ratio was 1.78.

Sugarcane Cultivation

Unlike sericulture, cultivation of sugarcane is an annual crop. The data on cost of cultivation shows that sample farmers, incurred an average of Rs.40640.59 per acre/year. Among cost of different inputs used, labour cost was Rs.11,454.64, followed by critical inputs Rs.10,764.98 and other expenses Rs.18,420.97 of total cost of production. Although cost of labour was high in sugarcane cultivation, its magnitude was low when compared to sericulture. It means that labour intensity was low in sugarcane cultivation.

Table 1. Cost of cultivation of cocoon and other agricultural crops

(Rs./acre)

Sl.No	Particulars	Sericulture	Sugarcane	Turmeric	Banana
1	Human labour	27343.62	11454.64	5818.61	4512.05
2	Animal power	1999.66	1372.86	1446.38	1450.75
3	Machine power	-	371.25	1522.50	278.60
4	Farm yard manure	5253.26	5440.34	7213.01	6990.76
5	Seed	5777.54	8750.00	6800.75	6300. 50
6	Chemical fertilizer	4407.20	2178.94	2941.31	5750.40
7	Irrigation	3803.26	3145.70	4230.69	4286.76
8	Plant protection	5228.40*	1523.45	3890.50	2890.45
9	Land tax	180.00	125.00	175.00	167.75
10	Marketing	1455.75	3268.00	960.75	2780.60
11	Others	7535.52**	-	-	-
12	Interest on working capital @ 8% p.a.	4435.89	3010.41	2799.96	2832.69
	Total cost	67420.10	40640.59	37799.46	38241.31

Note: ** Includes disinfections material used in silkworm rearing*
*** Refers to fixed cost of rearing house and appliances used*

Table 2. Yields and returns in sericulture and other agricultural crops

Sl.No	Particulars	Sericulture	Sugarcane	Turmeric	Banana
1	Yield (t/acre)	0.926	52.500	2.38	10.21
2	Returns (Rs/acre)	120703.92	55021.42	53551.78	80710.05
3	Net-profits(Rs/acre)	53283.91	14390.83	15752.32	42468.74
4	Input- output ratio	1.78	1.35	1.42	2.11

In terms of gross returns, sugarcane cultivators realized Rs.55021.42 per/ acre, which was less as compared to sericulture. The input-output ratio was also less (1.35) for sugarcane. This implies that sericulture occupation generates higher income than sugarcane cultivation in the study region.

Turmeric Cultivation

Turmeric cultivation is another important commercial crop in the Gobichettipalayam region of Erode district. Field observations revealed that the availability of water sources from Bhavani Sagar Reservoir encouraged farmers to cultivate turmeric on a large scale. The total cost of cultivation on turmeric was Rs.37799.46, of which cost of labour, critical inputs and others were Rs.5818.61, Rs.14,385.01 and Rs.17,595.84 respectively. The highest amount was incurred to critical inputs, which was more than labour cost.

The estimates on income and input-output ratio for turmeric were Rs.53551.78 and 1.42. Generally, returns from turmeric cultivation would be higher than other crops, but due to frequent changes of turmeric prices in the market, the returns also vary. As a result of that income earned in turmeric was less as compared to sericulture and sugarcane crops during the study period.

Banana Cultivation

Banana was cultivated on large scale under assured irrigated condition. The total costs incurred for banana were Rs.38241.31 per acre/year. It was very less as compared to sericulture but on par with sugarcane and turmeric cultivation. The cost analysis shows that labour cost was Rs.4512.05, indicating cultivation of banana is less-labour intensive than sericulture. Like sugarcane and turmeric crops, the cost of critical inputs together contributed higher side (Rs.17,027.92) than other inputs. This was also higher as compared to sericulture, sugarcane and turmeric cultivation. The total income obtained from banana was Rs 80710.05/acre/ year. The input and output ratio was 2.11. This was higher side than sericulture, sugarcane and turmeric. It is because of the fact that cultivation of banana crop was a far more productive venture than other crops in the study region.

Mulberry sericulture has been found quite profitable in several aspects. It has provided higher net-returns per acre/year than sugarcane, turmeric and banana cultivation

Conclusions

Mulberry sericulture has been found quite profitable in several aspects. It has provided higher net-returns per acre/ year than sugarcane, turmeric and banana cultivation. Bivoltine sericulture produced higher input-output ratio as compared to other crops except banana in the study region. Therefore, sericulture can be encouraged to cultivate on large scale in the study regions. Efforts are to be made by Department of Sericulture (DOS) to popularize high yielding mulberry technologies and cost reduction improved rearing practices to adopt farmers to increase productivity and income in bivoltine sericulture in the study region.

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JS Tomar—Demise of a Doyen

Tribute to Mr. Tomar for his unparalleled contribution to agricultural credit

By **Jayshree Vyas***

This is to share with you with great pain that our former board member Mr. J S Tomar passed away on 1st July 2010 in Delhi. The sector's relationship with him started when he was working in the capacity of General Manager with Oriental Bank of Commerce (OBC). Way back in 1995, when commercial banks were hesitant to enter the microfinance territory, in OBC, he led replication of *Grameen* model of rural banking in Uttarakhand and later in Rajasthan.

During his banking tenure, recognising the pioneering work done by Mr. Tomar in microfinance, the Reserve Bank of India appointed him as an Officer on Special Duty in charge of a micro-credit cell. While working there, Mr. Tomar converted the recommendations of the National Microfinance Task Force of 1999 (headed by Mr. Nanda) into a series of RBI circulars. This opened the door for banks lending to MFIs under

the priority sector. We all know how central that has been to the growth of the sector. He was also the adviser in microfinance matters to AFCL.

Late Mr. Tomar had been a great support for the microfinance sector while he was with the bank. Apart from serving in the board of *Sa-Dhan*, his contribution will be remembered as a member of the various subgroups within *Sa-Dhan*. After retiring from OBC, Mr Tomar, joined as CEO of Cashpor Group of Companies. He contributed immensely to the growth and stabilisation of Cashpor, along with its visionary Chairman David Gibbons. After serving five years as CEO, he stepped down very gracefully, and continued to provide support to Cashpor as an active independent Board member.

Tomar was a regular contributor to leading financial dailies i.e. Economic Times, Financial Express, Business line, Observer etc and authored a few books on Land Reform, Rural Development and agrarian policies.

Our hearts go out to his family, friends and to all of us who have been taught and inspired by him. He will be dearly missed, but there is no doubt that his spirit and example will live on. We at *Sa-Dhan* join our friends and colleagues in the microfinance sector in mourning the unexpected passing of Mr. J S Tomar.

*(*The writer is Chair of Sa-Dhan)*

AGRI NEWS

Portal for Agri Exporters Launched

The Government of India has launched a portal, **www.efreshindia.com**, to bring farmers, Agri exporters and customers on a single platform. Launching the portal on 11 August, Union Minister for Food Processing Industries Subodh Kant Sahai hoped that the portal would empower Indian farmers to global connectivity as they will get precise information about the produce and the suppliers in their own language.

The Minister urged the portal operators to take this facility to the Panchayats as the farmer functions through Panchayats only. Sahai also suggested that the portal should contain information regarding the connectivity of the farmer to the market and the cold chain available to him.

The portal, seeks to empower Indian agriculture based on a food chain concept. It is farmer friendly and farmer centric. It creates connectivity between the suppliers and the buyers through trading platform. The portal will help farmers to increase income through higher agricultural productivity. It will specially focus on north eastern states. The portal now available in English and Hindi will soon have versions in Marathi, Telugu, Gujarati, Kannada, Tamil and Bangla.

Rubber Board to promote Mechanisation

The Rubber Board has introduced a scheme to promote farm mechanization in the rubber small holding sector to contain the shortage of labour forces. Under the scheme, financial assistance would be given to Rubber Producers' Societies (RPSs), Rubber Self Help Groups (SHGs) and Companies promoted by Rubber Board for purchasing weed-cutting machine. The amount of assistance would be 50 per cent of the actual cost of the equipment limited to a maximum of Rs 14,500. The assistance would be for the purchase of a maximum of three machines by each company in the RPS sector and two by each RPS/SHG during the 11th Plan period, an official press release said.

India-Argentina Sign Pact on Agriculture

India and Argentina on 2 August signed a joint agreement agreeing to develop technical and professional cooperation in the agricultural sector and foster the trade of plants and animal products between the two nations. Argentina's Agriculture, Livestock and Fisheries Minister Julian Andres Dominguez and India's Agriculture Minister Sharad Pawar signed a joint agreement recognising the benefits of cooperation in the field of agriculture and the allied sectors, including the agro-industrial sector, towards economic and social development of the two countries. Dominguez also invited Pawar to visit Argentina.

AGRI NEWS

Mobiles Helping Farmers to Gain Income

A study by New Delhi based think tank ICRIER in a study revealed that farm information-enabled mobile telephony is having a beneficial impact on small farmers. The study on Socio-economic Impact of Mobile Phones on Indian Agriculture stated that despite erratic services and irrelevant information, small farmers from Maharashtra (income between Rs 12-17,000/month) reported the highest use of their phones to access information, leading to diverse benefits.

These included yield improvements, price realisation and better adjustment of supply to market demand. They could also afford more personalised services and superior text messages. In contrast, benefits were limited only to improvement in yields among low income farmers of UP and Rajasthan. Awareness on the range of customer support service

provided in these states was low, restricting two-way communication. Significant improvements in supporting infrastructure and capacity building amongst farmers are critical.

Small and marginal farmers, who are the vast majority of 127.3 million cultivators in India, are often unable to consistently access information that could increase yields and lead to better prices for crops. A 2005 NSSO survey found that only 40 percent of farmer households accessed information about agricultural techniques and inputs. Small farmers prioritised weather, plant protection (disease/pest control), seed information and market prices as the most important issues.

Close to 90 percent of UP and Rajasthan farmers studied ranked seed information as the highest priority while over 70 percent cited market prices as most important.

IFFCO eyeing overseas tie-up for its Nellore dairy project

The world's largest farmers cooperative IFFCO has announced that it is negotiating with two global players for setting up an integrated dairy in its upcoming food-processing SEZ at Nellore.

IFFCO is also in talks with a Russian company for setting up a fertiliser plant there, Managing Director U S Awasthi said. "We are negotiating with a firm in the US and New Zealand for setting up an integrated dairy in our farm-based food processing SEZ (special economic zone) in Nellore," Awasthi informed.

The proposed dairy envisages an investment of Rs 1,000 crore. Besides equity partner, the overseas firm would also be a management partner in the

venture, he said, but marketing will be done by IFFCO.

The venture would have around 6,000 livestock, which will be imported to begin with "however, later we will develop a local cross-breed," Awasthi said. IFFCO is also scouting for a partner to set up a fertiliser plant in Russia.

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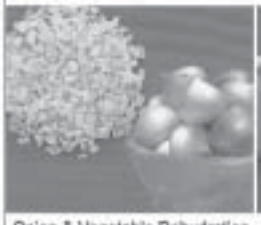
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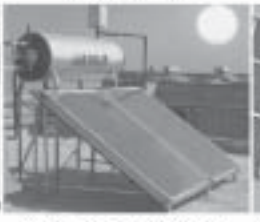
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